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THE GEOGRAPHICAL JOURNAL

Vol LXXIV No 5 November 1929

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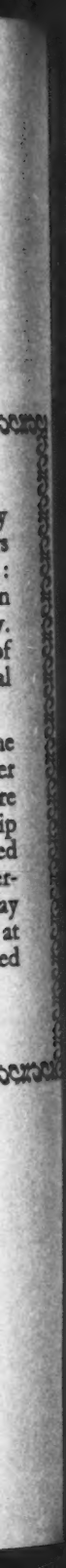

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The
GEOGRAPHICAL JOURNAL

Vol LXXIV No 5 R.G.S. *November 1929*

SOME PROBLEMS OF ARCTIC TRAVEL: AFTER A FORCED LANDING: *A paper read at the Meeting of the Society on 15 April 1929, by*

VILHJALMUR STEFANSSON

A TOPIC has been set me this evening—to discuss those basic conditions upon which safety may depend in case of forced aeroplane or airship landings on moving Arctic pack far from shore.

It is only a matter of form to say to a learned and critical audience that the most honourable travellers have frequently written in books and reports things that were incorrect. Sir Edward Parry was perhaps the greatest of British Arctic explorers. Like McClintock, who alone may have been greater, Parry had that independence of judgment which made it easy for him to recognize the mistakes of his predecessors. Yet Parry reported that polar cattle (musk oxen) leave Melville Island in the autumn, travelling south, and return to it in the spring. We know now in general that they do not migrate from any island to any other, and in particular that they do not migrate from Melville Island either south or north. Because he had never doubted what some one had told him, even Parry was guilty of implying he had seen a thing which neither he nor anybody else has ever seen. Almost any one, then, may report as an observed fact almost anything which he believes in, if he has never heard it questioned.

When Commander Byrd flew from Spitsbergen to the North Pole and back, he reported that he had seen no seals in the vicinity of the North Pole. A year later he reported seeing no codfish on his flight from Newfoundland to Ireland. Many took his observations of 1926 as having an important bearing on whether there are seals around the North Pole, but no one took his observations of 1927 as having any bearing on whether there are codfish on the Newfoundland Banks. This proves what needed no proving, that when you want to you will take much stock of negative testimony, and that when you don't want to you will pay no attention to it. There is no testimony as to the absence of life from any part of the Arctic Sea which is more convincing, on the face of it, than the testimony of Parry about the migrations of polar cattle. Many of the reports have no more bearing upon the real issue than had Commander Byrd's failure to observe cod in the Atlantic.

If negative testimony were of any great value, the death by hunger of every man who did not die from disease in Sir John Franklin's last expedition might seem conclusive. That tragedy would prove that no human beings could live there by hunting, except for the fact that Eskimos do live there by hunting. Next it might prove that Europeans could not live in that district by hunting, but Europeans have lived there since by hunting. Then it might prove that Europeans of Franklin's time could not live there by hunting, but John Rae lived by hunting near there at that time in an environment which no judge, so far as I know, has voted superior. Lastly, the Franklin disaster might prove that the party was too large, except for the fact that equally large numbers have subsisted in that district by hunting. In fact, the sweeping Franklin tragedy does not prove anything except the inability of those particular men to live under those particular conditions.

The seal is the great mainstay of those who live by forage in the Arctic. The abundance of seal around King William Island must have been well known to Franklin's men, who through some strange mental bias were nevertheless unable to make use of them. But their complete absence has frequently been reported from other districts, where they were later found abundant.

In the autumn of 1851 Captain Richard Collinson, later Admiral, put the *Enterprise* into winter quarters in Walker Bay, Victoria Island. This was in the middle of that great search for Sir John Franklin during which we gained most of the knowledge we have to this day about the outlines and topography of the far-flung archipelago that stretches poleward from Canada. Walker Bay is on the west side of Victoria, the third largest of the Canadian islands, more than 400 miles north of the arctic circle. Collinson was prepared for a winter of desolation. He expected the caribou to move away when autumn came. As a matter of fact, most of them did then and do now. This, however, is a peculiarity of Victoria Island and nowise general for the Canadian archipelago. McClure at the very same time was discovering in the next island west, Banks, that in midwinter the caribou came from the south and gathered towards the north around the Bay of Mercy. They still do that in Banks Island in winter, as we found when we spent three years there recently (1914–1917).

Collinson did not understand, as we do to-day, that fresh meat will prevent scurvy. He wanted the meat, however, as a change in diet for his men and also because of the belief, general then as now, that meat is a wholesome food and particularly nourishing. He would have liked to secure seals, but the ice froze over the bay and later over Prince of Wales Straits beyond. From autumn till spring they got no seals. To those who believe in Arctic desolation the Collinson report would mean either that seals were absent in winter or unobtainable. To those of another view, Collinson proved only that Collinson had observed no seals.

In the late summer of 1907, Captain William Mogg, of the auxiliary whaling schooner *Olga*, prepared for wintering in the same Walker Bay. This captain had been in northern whaling for twenty years, the larger part of that time in the Beaufort Sea. He had an Alaskan Eskimo wife and a family of children. More than one of his officers had a western Eskimo wife, and a third or half the crew were Eskimo from Cape Bathurst, the Mackenzie River, Herschel Island, or Alaska. Like the captains of the long-past Franklin Search, Mogg

was unaware that fresh meat prevented scurvy, but did have the general opinion that the health of his people would suffer without it. Far more expert than Collinson's men as hunters, the western Eskimo crew ranged widely through the hilly neighbourhood and secured a few caribou. They sealed energetically at the floe edge and procured a large number of seals. As the winter cold increased and the floe moved farther and farther away from land, the hunters lengthened their journeys until the sealing waters were so remote from the ship that they could not go and come in a day. Then they began to camp at the floe, sending sledge-loads of meat back to the ship according to the hunting fortune. But eventually the free water disappeared; the bay and the strait were frozen immovably. Then sealing stopped, and it did not occur to either the Captain or his crew, whether white or Eskimo, that any seals could be secured until the following spring when they would begin to come up voluntarily and bask in the sun. Had the story ended there, Mogg's Eskimo could have been cited as confirming the verdict of Collinson's Englishmen, that seals were either absent from Walker Bay in winter or unobtainable.

The people of the *Olga* knew that there were natives in Victoria Island. This had been reported by Captain Charles Klinkenberg, who had wintered at Cape Baring the year before, the first white man to land anywhere west of the east coast of the island since John Rae in 1851. They were said to be strange people, for it was Klinkenberg who had revived Franklin's report of a century before that some of them resembled Europeans.* It had been a chief purpose of Captain Mogg on the present voyage to reach these people, make friends, and buy from them a large ethnological collection. He was expecting to go in search of them by April if they had not come before, but he was hoping for an earlier visit, since that had been the fortune of Klinkenberg.

There was pleasurable excitement aboard the *Olga* one day in March when it was reported that natives were approaching in several sledges. There was the thrill of receiving first visitors in a strange land, the slight fear of danger, and the great expectation of friendly intercourse and trading profit. The ship made preparations to receive the visitors. Eskimo who had been with Klinkenberg were put forward to welcome them aboard. There were laughter and greetings with slaps on the shoulder, and friendly signs of every sort. Then came food, for among the Eskimo, as elsewhere, this is the most important courtesy to a visiting stranger and should be an early one. Here was a difficulty. The captain knew that his visitors preferred fresh meat to all other foods, but there was none and there had been none for months. The *Olga* crew had long been in the habit of remarking that they would give an arm, a leg, or a soul for a piece of fresh meat, seal or caribou.

At this stage one of the Alaskan Eskimo told his captain that he was much worried about the visitors, for he had been down looking at their sledges and had convinced himself that none of them carried any food. Said the captain, then, that this might be lucky, for the natives would have to like his European foods if they could get no other, and would be under that much more obligation to the ship's company who were able to feed them, even if it was not on

*Vilhjalmur Stefansson, 'My Life with the Eskimos' (American Abridged Edition), p. 199.

the diet preferred locally. But, surprisingly, the visiting natives made no effort to consume more than the smallest bit of each white man's dish offered them. They swallowed a few mouthfuls, as politeness demanded, and then explained that bread, salt beef, and sugar were no doubt really good to eat, but that these and all the rest were strange to them and therefore not palatable. The captain and the crew, both western Eskimo and whites, decided that the natives must have had a meal recently, and said to each other that by evening or the next morning they would be glad of the ship's provisions. But things went otherwise. As soon as local good manners permitted, the natives clambered down from the ship to the ice and rambled off a hundred paces or so. Then each householder selected his own particular snowdrift, the knives came out, the blocks took shape rapidly, and a village of domed houses began to rise. An hour later each family had a dwelling built. Thereupon the able-bodied men took each a dog on leash and walked radially away from the ship in every direction, going slowly and permitting the dogs to sniff and prowl about. Some went only a few hundred yards, others half a mile or even a mile. Inside of two hours the first man was on his way home, his dog dragging a seal. A half-dozen hours later most, if not all, the hunters were back successful. The women and children had in some cases not finished spreading bed skins and putting to rights the simple furnishings of the snow houses by the time the men were home with the food supply.

When the seals began arriving from various directions, Captain Mogg began to chide his western Eskimo crew, asking why they had travelled so far in the autumn for game that was only a few hundred paces away, and why they had whined about the lack of fresh meat all winter and then made a practice of walking around for mere exercise where seals were lying no more than a fathom deep below them. The Eskimo replied that the method of sealing which they now saw in use by the Victoria Islanders was known to them only through old men's tales which they had disregarded or disbelieved. Others said they had believed in the truth of the stories, but had considered the art of sealing through ice to be permanently lost.

I have the above story in manuscript from William Baur, the most literate member of the *Olga* crew. He was steward for Captain Mogg, and later steward for me both on the *Mary Sachs* and the *Polar Bear*. I have the same facts as verbal information from Captain Mogg and from several of his crew, both Eskimo and whites. Such stories, for you can get many of them from books in various languages, show that the presence of Eskimo hunters on an expedition does not necessarily prove that game was absent from districts where none was seen by them during a whole winter.

So as not to becloud an argument which means to strive at nothing but a true conclusion, we must point out that inability to secure even those animals that are visible is almost as common among Eskimo as it is among Europeans. For instance, Rasmussen had Greenland Eskimo with him on a return journey from the north coast of Greenland, where again and again he mentions seals basking on sea-ice when neither he nor his companions were able to capture them. South Greenland Eskimo are expert in kayak hunting; the north Greenlanders are evidently good bear hunters and are skilled with walrus and seal under certain conditions. But under the conditions that met

Rasmussen on his journey, no one in his party was able to secure animals that would have fallen easy prey through Mackenzie River or Alaskan methods. This dovetails in with what we have shown above, that Alaskan methods were in turn inadequate for winter sealing around Victoria Island.

The traveller who expects to live by hunting in the Arctic should be the master of every Eskimo technique, from Eastern Greenland to Western Alaska, and he should have at his command, in addition, every portable device which Europeans have invented and every art which they have discovered. Ideally, he should have gone further, by combining European knowledge and equipment with Eskimo knowledge and equipment in such a way as to bring forth something higher and more complete than a mere sum of the two. Early European explorers tried to develop polar technique from their inner consciousness. Later travellers have borrowed Eskimo methods wholesale. The ideal thing is to borrow the Eskimo technique, master it, and then improve upon it, for perfection is no more likely to be discovered on Coronation Gulf than in London or New York.

Various books of mine explain how, through an aggregate residence of more than eleven years inside the arctic circle, I gradually came to the view that we have neither observations nor reliable scientific principles from which we can deduce that animal-life is more likely to be rare in certain unvisited parts of the northern ocean than in certain unvisited parts of any other ocean. The various doctrines to the contrary I classified in my own mind as folk-lore, pseudo-science, or deductions from inadequate and too few observations. I did not know that animal-life would be found in certain places where no one had been, but I thought I knew that no one knew that it would not be there.

From the reports of all travellers who had been in or near the Beaufort Sea before us, it was to be deduced that no part of the so-called Frozen Ocean has in it ice that is heavier or more sluggish in movement. This district is the traditional home of paleocrystic ice, as we call the oldest and heaviest floes known. There was, then, every reason to think that the Beaufort Sea would be the centre of desolation. I know of no authorities who wrote before 1913 and did not agree with this view, if they expressed themselves at all. For instance, the President of the Royal Geographical Society of the time, Sir Clements Markham, stated the common scientific view when, on p. 172 of his biography of Sir Leopold McClintock, he spoke of the sea to the west of Prince Patrick Island as "the polar ocean without life." Yet we later found no difficulty in living by hunting in this particular section of the Beaufort Sea.

Although we now have the testimony of several travellers of our third expedition that the Beaufort Sea is full of life, we have also one more theoretical reason than Markham had for believing it lifeless. For we have proof of what he no doubt suspected, that the currents west of Banks and Prince Patrick Islands come from the north-west or north. If you are, then, 200 miles from shore in that sea, you are travelling over floes that have been farther north recently; they are floating in water that is coming from the north. If either distance from the equator or distance from open water is the cause of lifelessness, then, as I have said, the reason is greater than Markham knew for believing in the extreme scarcity of life in the Beaufort Sea.

In fact, the arguments appear so strong to those who still give weight to the

old basic principles, that some authorities are still applying to the reports of my third expedition a criterion which I believe was first clearly formulated by the Scottish philosopher, David Hume, to the effect that it is more probable that a thousand normally truthful men would all tell the same lie than that one miracle should occur. For, to the holders of the classic views, it seems either the statement of an untruth or of a miracle when I say we found life abundant, and living by hunting easy, in the Beaufort Sea 200 miles north of Alaska, though the waters in which we hunted were clearly coming from the north.

The old view is most quotably stated by Amundsen* in his autobiography, 'My Life as a Polar Explorer,' published in Norwegian some two years ago. This statement is not found in either the British or American editions. He says:

> "No misrepresentation more outrageous has ever been published than the statement that a skilful hunter can live by hunting on the floating ice of the polar sea. Stefansson has never done it, although he says he has. I am willing to stake my reputation as an explorer and will wager everything I own that if he were to try it, he would be dead within eight days counted from the day of starting, if only the experiment is made on the floating ice out of sight of land."

The opposite view has been stated by Wilkins,† who says that on his trans-arctic flight of 1928 he carried provisions for only some three weeks, but nevertheless felt confident, on the basis of his experience with my expedition of 1913–18, of which he was a member, that if he and Eielson were forced down anywhere on the polar sea, they would be able to walk ashore in reasonable comfort, living by hunting, even though the journey to land and people might require two years.

With the views of Amundsen so directly opposed to those of Wilkins, and with the fundamental differences that there are, for instance, between Nansen and myself, it must be considered that, so far as the weight of mere authority goes, the question is still open as to whether the Arctic is in the larger part of it so poorly supplied with life that a skilful hunter has little or no chance of being able to live by hunting. But Wilkins staked his life and success many times on the proposition that living by hunting anywhere on the Arctic Sea involves no more than a reasonable hazard; and I had staked my own life, as well as those of several other members of our third expedition, on the same proposition many times before. The public may, then, consider the question open, but I consider it closed. I shall accordingly discuss the technique of Arctic travel on the assumption that game is more abundant on the average over the Arctic Sea than it is on the average over the Arctic lands. It is admitted, of course, that living by hunting on Arctic lands is possible since it is being done, or has been done, on most of them.

Apart from the presence or absence of game, there is a second fundamental question as to living by hunting: whether you can keep in good health indefinitely on meat alone. A few centuries back this discussion might not have been serious in England, for I think it was Samuel Pepys who speaks of a "sumptuous fine dinner" where all the courses were meat except one that was

*Roald Amundsen, ' Mitt Liv som Polarforsker' (Oslo, 1927), pp. 210–211.
†George H. Wilkins, 'Flying the Arctic' (New York, 1928), p. 249.

meat and cheese. Nowadays, however, the propaganda of vegetarianism and the pseudo-science linked with it have made such progress that the average person is startled when he hears that you can transfer from a mixed diet to a diet of meat alone with less discomfort than if you transfer from a meat regimen to one that is mixed, and that the average health of all those who have tried it for long periods has been at least as good on the meat as on the mixed diet. Take, for instance, the contrast between two well-known expeditions—Scott's first in the Antarctic and Nansen's last in the Arctic.

At the beginning of his Antarctic winter, Scott found himself with a varied diet that had been prescribed for him by the current dietetic opinion of England. There were medical men on his staff, the health of the crew was supervised as to eating, cleanliness, ventilation, and exercise, and still there was a good deal of scurvy before summer, including the serious breakdown of Shackleton on what might otherwise have been a much longer journey into the continental interior.

At the beginning of their last Arctic winter, Nansen and Johansen found themselves with no European food and with few other resources, on the shores of one of the Franz Josef Islands. They built a hovel of stones and roofed it with the hides of walrus dripping with oil. There was no window and the poorest ventilation. The only food was meat, chiefly polar bear. The fuel was blubber and the light was animal oil, both burning with smoke and stench, There was never a bath all winter, seldom if ever a washing of hands or face, no variation in the constant meat diet, no systematic exercise or other orthodox precaution for health, and no result except the most perfect health all the winter and the thorough fitness of both for the strenuous work of the spring.

My own experience is no more conclusive than that of Nansen except that it is longer. During a thirteen-year period I lived for something more than eleven years inside the arctic circle, and estimate that of this period I lived on meat alone for an aggregate of more than six years. There are some who believe that such a diet will lead to high blood pressure, hardening of the arteries, breakdown of the kidneys, rheumatism, and, in short, to premature old age. But I was examined by a committee of specialists after my return to the cities, and none of these expected symptoms were found, nor any others that have ever been supposed to be due to a meat diet. Moreover, I have lived on meat and water for a year under the ordinary conditions of New York City business life, and found my health as good and the results as generally pleasant as they had been in the Arctic. The belief that a mixed diet is more wholesome than a diet of vegetables without meat or of meat without vegetables is, so far as I know, merely a passing phase of medical and dietetic opinion. It may be destined to be established by scientific research hereafter. Meantime a flyer who lands perforce on the northern pack may be sure of reasonable health and comfort for a year or so if he knows how to secure and utilize seals, how to build a snow house, and a few more details of Arctic technique.

Third in importance for the northern flyer, after deciding whether game is found in the Arctic and whether one can live on meat, is to consider the landing conditions on the Arctic pack, whether the landings are voluntary or forced. There have been two theories about aeroplane landings on pack-ice.

Among the practical flyers, Sir Hubert Wilkins is the chief exponent of the view that landing places are numerous. The leader of the contrary view was Amundsen. The difference in opinion rested on differing experience and training as well as on difference of personality. Wilkins had learned flying from Graham White in 1910, had flown before that as a passenger, and was, when he joined my expedition of 1913, the first practical flyer that ever went to the Arctic. During the three years he was with us he was always studying land and ice from the flying point of view, always remarking that here you could land safely and here you could take off again with planes mounted on skids. In contrast to this, Amundsen was not a flyer and had not the flyer's point of view. More significant, he had only book and hearsay knowledge of the Arctic pack. For, prior to his flight with Ellsworth in 1925, his whole polar experience had been on board ship, on the landfast ice of the Arctic, or on the land ice of the Antarctic, with no experience at all of travelling over drifting floes. The opinions of Wilkins and Amundsen were therefore no more opposed than their training would lead you to expect.

It had been said by many northern travellers, among them myself, that even in winter there is usually a great deal of open water in the moving pack. This appeared to be contradicted by the observations of the first Amundsen flight, for he reported that in 600 miles north from Spitsbergen he had seen no suitable landing-place for a flying-boat except the one where he came down. But it has to be remembered that Amundsen waited for days, if not for weeks, until the meteorologists assured him that the weather was particularly calm between his base and the North Pole. It is under such conditions of temporary calm that the normally fractured ice is cemented together into transient aggregates of vast extent. In waiting for calm weather Amundsen had been waiting for the very condition most hostile to the equipment he was using, which would make it temporarily difficult for flying-boats to discover a landing place.

At the end of his notable airship flight to Alaska from Spitsbergen, Amundsen said* that on the whole journey of something like 2000 miles they "did not see a single landing place. Not one" suitable for aeroplanes mounted on skids. In the face of this testimony Wilkins continued to maintain that Amundsen misjudged the pack because he had never travelled upon it afoot, and that it was impossible for a man lacking that experience to judge landing places from the flying height of the *Norge*. Thorough trial would eventually show, he contended, that on an average there is at least one fairly good landing place for a plane with skids every 5 flying miles over the 2 or 3 million square miles of the Arctic pack. This would mean that flying high you could normally glide to a safe landing in case of engine trouble.

A dramatic trial of theories between the Amundsen and Wilkins schools came in the late winter of 1927, when Wilkins, piloted by Eielson, flew northwest from Barrow, intending to make a round trip of 1400 miles. They had gone about 550 miles and were more than 400 miles beyond the limit of previous exploration when it became necessary to land because of engine trouble. Wilkins selected a promising spot, and Eielson came down to a perfect landing. While they were tinkering the engine a storm began to blow from landward,

*Roald Amundsen, ' First Flight Across the Polar Sea' (London, 1927), pp. 117–118.

making a direct flight towards shore advisable. They took off for Alaska, but had been in the air less than a quarter of an hour when engine trouble forced them down once more, this time with the landing field obscured by falling snow and a low blizzard. Nevertheless they made a second perfect descent. After the second take-off the wind freshened steadily, the blizzard thickened and night came on. They were flying a mile high two hours after dark in the combined obscurity of storm and night when the engine stopped suddenly. The fuel was all gone. Naturally the Wilkins idea of one safe landing place every 5 miles does not mean that you can land wherever you like. It means, on the contrary, that more than half the surface is usually unsuitable for landing. It was chance, then, combined of course with the great skill of Eielson, that brought the aeroplane down to its third safe landing.

Wilkins was the pioneer, then, not only in the theory that landing places are numerous on the Arctic pack but also in the practice of using them. The most conclusive demonstrations came, however, in the Nobile rescue operations. It is agreed that the pack is smoothest when farthest from land. Such margins of the pack as you find around Spitsbergen would be comparatively bad at all times of year. It is further agreed that the rains and thaw waters of spring corrugate floes that were previously smooth, making conditions doubly and trebly bad. The flyers of many European nations were, therefore, operating for the Nobile rescue in one of the worst districts and at the worst time of year, so far as skid landings are concerned. Yet the planes equipped with skids landed almost at will. It was those who had been misled by the then current European doctrine of the preferability of flying-boats who had the most trouble.

In fact, it is a disappointment in reading the Russian accounts of their operations of planes with skids to find them remarking offhand, "we landed on a floe," "we took off," etc., without troubling to describe the conditions. Things were so simple and easy that there evidently appeared to them nothing worth describing. But the mere statistics of their performance are impressive. Babushkin, for instance, who operated from the *Malygin*, took off something like a dozen times and made a corresponding number of safe landings, half of them in thick fog or snowstorm. Only once did he have a slight accident, such as may occur on a prepared landing field and could be repaired in a few hours where machine shops are available.

It is established, then, that there is no equally large natural terrain in the northern hemisphere where landing places are so numerous as on the Arctic pack. These are most numerous farthest from land, and they are more numerous in winter than in summer. The worst localities are nearest the edges of the pack, and the worst season for landing is the summer.

A year or two ago I read in a British magazine the account of a northern journey that failed through cold, storm, and resulting hardships. This was written by an Inspector of the Royal Canadian Mounted Police and described winter operations around Great Slave and Great Bear Lakes in sub-Arctic Canada. The first or second night away from the home base the party suffered terrible hardships through being compelled to camp in a blizzard on a small island in Great Slave Lake, where they had no shelter but tents, nothing for fuel except kerosene and driftwood, and no protection from the inclement

breezes. This story, and many like it, impress you with the terrible hardships of Arctic travel, for, by inference, you would think that 500 or 1000 miles farther north the conditions would be more difficult and the suffering more intense.

For a comparison of travel method and resulting hardship or comfort, read, in the Appendix to my book 'The Friendly Arctic,' the story of five members of the expedition written by one of them, Storker Storkerson, who at that time was second-in-command. They had started from a point on the north coast of Alaska many hundreds of miles farther north than Slave Lake. They had left behind all driftwood and every chance of shelter from tree or bush, yet they travelled in comfort, northward over the shifting floes. When they had made 200 miles from land—100 miles farther than any explorer had penetrated in that region before—they sent back with a support party the report that they had travelled thus far without hardship or suffering of any sort and that they had made camp on a floe that was more than 5 miles in diameter, intending to drift with it for six months or possibly a year, living by hunting.

At distances varying between 200 and 300 miles from shore, they did drift with that floe 450 miles in six months, living by hunting and taking occasional soundings which showed the greatest depths ever recorded up to that time in the polar sea. Then one of the party was taken ill with a disease which present-day medical opinion agrees had nothing to do with their conditions of life, a disease found in every zone of climate, among all classes of people, idle or labouring, rich or poor. This made them start for shore. The time was October, generally considered the most dangerous and difficult month of the whole Arctic year. But they made land after a total absence of eight months, and reported that, apart from this one illness, from which the patient largely recovered on the way ashore, they had experienced no hardship, lived without discomfort, and were of the opinion that they could have resided on their floe as safely and comfortably six years as six months—unless, indeed, the floe had drifted sooner into north Atlantic waters to melt and disappear.

The difference between the stories of the Police Inspector and of Storkerson is in temperament, in point of view, and in skill. We know how to erect windbreaks on the polar sea that are more cozy than the shelter of a heavy spruce forest ; we know how to build snow houses that are warmer than any tent and that scarcely yield in comfort to a room in a good hotel. We know how to travel with a minimum of baggage, for we can secure food, fuel, and even materials for clothing wherever we are on the seas. We can do the same on Arctic lands, except the few that are glacier-covered.

The flyer who speculates on aeroplane or dirigible wreck in the Arctic can discover much comfort in typical stories of what has happened there in the days of sail and steam. In the 70's of the past century, for instance, Albert Markham found himself on the polar sea 60 miles from land, with a party gradually weakening from the winter discomforts which travellers of that time did not know how to prevent, and weakening also from inadequate rations and from disease. He could go no farther. We marvel to-day that under those conditions he was able to go so far. On the way back his men one after another sickened, and finally one of them died. But they made headway every day

when it was blowing a living gale, and, with ten men incapacitated out of seventeen, they made shore.

In the early 80's of last century, Lieutenant DeLong, of the American Navy, had his ship, the *Jeannette*, crushed under him 200 miles from land. With several invalids in his party, including one man who was blind at the time, they all made the vicinity of land, every invalid gradually improving in health during the journey, and the man temporarily blind recovering part of the sight of one eye. One-third of the party were lost in open water almost within sight of land, and another third perished after getting to shore, but the fact remains that DeLong did carry his whole party across moving Arctic floes safely 200 miles.

In 1927 Wilkins and Eielson showed that flyers can do the like. When, as stated, they made their safe forced landing in night and blizzard on the pack north of Alaska, they did not know how far from shore they were. After a fairly comfortable night in the cabin of their plane, they discovered when the weather cleared that they were drifting on a cake of ice which their sextant and chronometer told them was about 100 miles north from Point Barrow. The petrol was exhausted, the drift of the floe was rapid, with open water all around. There was nothing to do except break up the aeroplane and fashion sledges against the time when the wind should stop, giving the frost a chance to cement the ice. They were carried 100 miles south-east in three days. When the drift stopped and the ice set fast they were about 90 miles from shore north-east of Point Barrow. Dragging their sledges, they walked this distance in eleven days, again without hardship except for the pain of Eielson's frozen fingers, a frostbite that had taken place before the forced landing, when he had been so careless as to work with bare hands on a metal engine with metal tools at 30° below zero.

But in 1928 the Nobile party followed none of these precedents. They found themselves, not 200 miles from land like DeLong, nor 50 miles like Markham, nor 90 like Wilkins, but less than 30 miles. They did not have ten men that were a burden on the party, like Markham, but only two. The direction and distance to land did not have to be determined by instruments, for land was in sight on clear days. There was no rapid drift away from shore as in the case of DeLong, or parallel to land, as in the case of Wilkins, for the winds and currents held the ice more or less stationary, jammed against the north of the Spitsbergen group. According to the ancient practice of self-help in polar exploration, the whole Nobile party should have commenced a movement toward shore after a day or two of preparations, the strong helping or, if necessary, carrying the injured. As an alternative, two or three of the ablest men should have started for shore at once with messages for relief. Three men did start out after several days. We do not know why they made so little progress. My own personal experience of travelling afoot for an aggregate of more than 1000 miles over this kind of ice makes it seem stranger to me than it does to most people. For with regard to the Arctic I am a little in the position of an American who has lived ten or twenty years in England. When such people return to New York and speak favourably of England, the common American reply is, "Oh, you have lived over there too long. You are prejudiced!" That is my case. I have lived so long in the Arctic that it is

home to me and its conditions homelike. It is correspondingly difficult to enter into the frame of mind that seems to have prevailed on the Nobile expedition and, indeed, among most of those concerned with the rescue.

By ancient practice, Malmgren, Zappi, and Mariano were not only right but praiseworthy in volunteering to carry out news. For up to that time, so far as the Nobile party knew, their radio signals had not been heard by anybody, and there seemed no prospect that they would be heard. But the radio signals had been heard and, in a sense, we of the old school who think Nobile's whole party should have walked straight ashore were proven wrong. We can do no more than argue that they would have saved themselves easily. But it has been settled by events that they were saved, though with difficulty by others. For the Italian flyer, Maddalena, discovered the Nobile party; the Russian flyer, Chuknovsky, discovered Zappi and Mariano; the Swede, Lundborg, rescued Nobile; and the magnificent persistence of the Russians on the ice-breaker *Krassin* brought to safety all that were still living on the ice.

It is clear that from every point of view it would be a good thing if people in such a position knew the technique of self-help which enabled Wilkins and Eielson to drift comfortably on an ice floe 100 miles at Arctic winter temperatures and then to walk ashore 80 miles without difficulty. That technique is simple, in a way, although tedious to explain. It cannot be made clear in a lecture or in a short article, but it can be in a book. I have already made it clear in a book of 800 pages, called 'The Friendly Arctic,' wherein several hundred pages are directly or indirectly concerned with the methods of comfortable living and safe travelling on floating sea-ice, on landfast ice, or on land. In such a book it is possible to explain why Nansen observed so little animal-life during the drift of the *Fram*, and still gave us no definite information as to whether the animal-life in the region he traversed is abundant or not. It is possible to explain how Peary could write in his last book that there was no animal-life in the polar sea adequate for the support of hunters, and how he could yet logically say in a speech before the National Geographic Society of Washington a few years later that he had reversed his opinion and now believed in the probable abundance of life in those regions which he had previously supposed barren. A book like mine, taken together with a careful reading of all of Amundsen's own books, can make it clear how Amundsen might be one of the greatest travellers and still no more necessarily an authority on the hunting conditions in the Arctic than Kitchener after his desert warfare was necessarily an authority on submarines.

In a book you can explain how a party of two or three men can stop on a hard snowdrift at 50° below zero, pull knives from their belts and begin the construction of a snow house, inside of which within two hours they will be sitting as comfortably as if they were in a hotel room, dressed lightly because the house is already warm, eating a meal in complete relaxation. A little later they will write up their diaries with fountain pens. Nothing in the house will freeze during the night unless it is down on the floor. The breakfast will be as leisurely and comfortable as the supper.

The mental results of the new style Arctic travel are as important as the physical. If you carry rations with you and expect to starve when they are done, there is constant nervous tension. But if you once acquire faith in your

ability to secure food, fuel and material for clothing wherever you go, you acquire at the same time the mental comfort known in cities to those with adequate salaries who have no fear of losing their jobs. There is an unparalleled sense of triumph over your environment when you stand on a snowdrift in a piercing wind and two hours later sit so cosily comfortable inside a house made from that drift that you have to stop to listen carefully to find out whether the wind is still blowing. You take next morning a cartridge that weighs only half an ounce, walk half a mile over the snow-covered ice that was "lifeless" to your predecessors, and return in half an hour (or after half a day) dragging a seal that gives you food, fuel, light, clothing, and even material for next summer's tent.

Peary, the supreme sledge traveller by the old methods, needed 6 pounds of pemmican each day for three men and 6 pounds of pemmican for six dogs, making 12 pounds for the average party with which we travelled for several years. We carried those same 12 pounds not as pemmican, but as ammunition. There are 33 cartridges to the pound, so there are 396 in twelve pounds. Through several years we have averaged more than 100 pounds of animals, live weight, for every cartridge fired. That means more than 3000 pounds for a pound of ammunition, more than 30,000 pounds for ammunition equivalent in weight to the twelve pounds of pemmican. We can go a year on the weight that carried Peary a day, and we have done it year after year, both on sea and land.

Obviously, then, during the pioneer stages of transarctic flying no party should try to cross without having with them at least one man who knows the complete technique of Arctic self-help. Preferably there should be more than one, for illnesses are possible there as here, and accidents do happen. Ideally every man should be able to do his share. Physically speaking, there is no reason why women should not play a part in the Arctic as well as men, for, even if they were less able to withstand hardships, there would be few hardships to endure in a party well equipped with knowledge and tools.

The equipment of tools is very simple. There is no point in carrying any form of firearm except the best rifle. The kind we have standardized on is the 6½ mm. Mannlicher-Schoenauer, but there are doubtless a half-dozen other kinds about as good—Mausers, Lee-Enfields, Springfields, Winchesters, etc. Each member of the party should carry the lightest and best field-glass of about six-power. These are mainly for finding and studying game that is or might be visible.

For finding seals in such regions as those from which their absence has been so frequently reported, you require a dog. Without him all the rest of your equipment and all the rest of your skill would be of no avail. He needs no special training and may be of any kind that has good wide nostrils and a keen sense of smell. He should be reasonably well furred, so that caring for him in bad weather need not be a concern of the party. Such dogs are to be used in what I have described in my books as the third or reserve method of sealing. That method is tedious and should not be used except where the other methods are not applicable. You may not have even one occasion for the dog hunting in a journey lasting several months, but you should carry him as a sort of insurance, like lifeboats and swimming belts on an ocean liner. More-

over, after a forced landing dogs are useful carrying or pulling their share of the baggage and well worth having even when their hunting skill is not required.

There should be cameras and notebooks, or the party will for ever regret it. For, granting that they are the right kind of party, there will be little suffering or worry and much of interest to record. The clothes should be woollen, for, although furs are much better, it is unreasonable to expect that many travelling parties can be educated to the proper care of furs. Without such care the best fur garments soon become useless. The sleeping-bags should be of one thickness for reasons which I have explained in my books, but for which there is no space here. The party should carry provisions in accord with the length of the journey—that is, the shorter the flight the more provisions. This sounds like a paradox until you get the meaning, which is that for a long journey you must use all your available carrying power for fuel and for lubricating oil. Moreover, nothing but hunting gear and skill can save you if you land anywhere near the midarctic, for nothing else is portable enough to take you 1000 miles to people. On such flights you should do as Wilkins did and carry provisions for only ten or fifteen days. But if you are making short jumps of 300 to 500 miles, there is no reason why you should not carry provisions for several weeks or even months.

Except for what we know has happened, it would seem unnecessary to insist that no equipment is worth carrying unless you understand thoroughly how to use it. It is on that principle that we decry the use of furs. They are best if you are skilful, but almost no one has the skill. The like is true of patent stoves. With the primus variety, for instance, the so-called needle used for opening the vent hole is about as important as the rest of the stove, and is very likely to get lost. A little impurity in the oil will render the best blue-flame stove worthless unless the stove has an infallible filtering arrangement. It was for this reason that Peary never carried any form of gas-burning kerosene stove. I have always had a tendency to agree with Peary on equipment, for he was the great master, generally speaking. Nevertheless I have always used blue-flame kerosene stoves, for I feel I understand every one of their vagaries, and can tinker them into use under practically any condition.

My own feeling is that the commander of a transarctic flight needs about two years of apprenticeship. After all, that is not much when you think of the apprenticeship necessary for taking ocean liners from Southampton to New York. To repeat, I have never known any one to become master of the use of fur clothing in less than a year or with less than the ruining of three or four suits of furs. It is about half as difficult as that to learn how to burn seal oil without any smoke and how to trim a lamp so that an evening adjustment will ensure that it will be burning bright and smokeless in the morning. Of course there will be devices invented that are fool-proof, but the trouble is that in an emergency you may lose those devices and may be thrown upon more primitive resources.

I realize that most of my advice regarding equipment is in the nature of a counsel of perfection. Prospective Arctic travellers are bound to be victimized by the specious advertising of all the expensive outfitters. They will take chances with complicated gear, hoping that nothing will go wrong between

starting-point and destination. In defence of carrying bulky and weighty provisions they will say, and will more or less believe, that they would rather die than eat seal meat, just as many Americans say and honestly think that they would rather die than eat snails.

And still ours is not wholly a counsel of perfection, for there are a few people who temperamentally delight in the laborious and slow mastery of technique. If some officer high among the Boy Scouts would take an interest, we might have from them a supply of candidates for Arctic flying who would know how to use fur clothing, how to build snow houses, how to discover seals where a Greenland or Alaskan Eskimo would swear none existed, and who would in general be as capable of dealing with the Northern Ocean as the sailors of the clipper ship days were of dealing with the Atlantic.

The kernel of this long discourse can be put into a sentence. Flyers who plan crossing the Arctic Sea need, in case of forced landing, the sort of training in self-help which enabled Wilkins and Eielson to get ashore with little difficulty from a plane abandoned 90 miles from land, and which gave Wilkins the confidence to say, after flying the Arctic from Alaska to Spitsbergen, that he and Eielson could have lived by hunting and made their way ashore even from a forced descent so far from people that the journey to habitations would have taken two years.

But what we shall actually have in northern flying will doubtless be gamblers, with skill awing but none afoot, who will take chances and die if machinery fails them.

DISCUSSION

Before the paper the PRESIDENT (Colonel Sir CHARLES CLOSE) said: Mr. Stefansson, who is to address us to-night, received the Founder's Medal of this Society in 1921, and all geographers, particularly all Fellows of this Society, know very well what he has done in the Arctic. But there may be a few visitors present who do not know so well, and so, for their information, I will say that Mr. Stefansson was born in Manitoba, and after studying in various Universities in the United States he became an instructor in anthropology at Harvard. In the year 1906 he undertook, not his first expedition, but his first in the Canadian North, and there he, for the first time, came into contact with the Eskimo. It was, I believe, largely owing to his contact with that extraordinarily interesting race, which I understand from him came about 2000 years ago from the centre, let us say, of the United States, that he got his clear notions as to how to live in the Arctic. Mr. Stefansson spent two years studying the methods of the Eskimo and improving on them, and in 1908 he again went up into the north, and for four years he continued his travels, his researches and his studies on the problems of the Arctic.

In 1913 he was appointed by the Canadian Government as head of the Arctic Mission which ultimately resulted in his being five years in the field. There cannot be many in this world who know so much about the Canadian Arctic as our lecturer, and those who have studied the subject will remember that he has written several books, amongst them that entitled 'The Friendly Arctic,' which gives an entirely different notion of those regions from that to which we are accustomed. Most of us think that the Arctic is a sort of inhospitable wilderness where we should not be very much inclined to spend longer than we could help. Mr. Stefansson has given quite a different idea of it; in fact, he has made it almost an attractive place, and perhaps after we have heard his lecture some of

us will trek off to the Arctic and see what it is like. Mr. Stefansson has the sympathy of all of us with his efforts to explore one of those regions of the Earth which not only we know very little about but in connection with which we owe to him a great deal of the knowledge we have. We hope that those Fellows of the Society who may be interested in the Arctic will follow in Mr. Stefansson's footsteps and study what he has done.

Mr. Stefansson then delivered the lecture printed above, and a discussion followed.

Sir DOUGLAS MAWSON: I do not think I can very profitably add to the splendid lecture we have listened to. I do not know a more interesting lecturer than our friend Stefansson. I cannot criticize his work in the Arctic because I have never done any work there, but am very interested in the story that he has told us. It has been most enlightening to hear him and to see the pictures.

He has made quite plain to us that there are two sides to the story of the Arctic regions. He has made clear to everybody present that there is a great barren region of ice in the interior of Greenland; also that the poppy-strewn verdant fields reported in the Arctic belong to the lowlands, which constitute the largest part of the Arctic region. The latter are, therefore, possibly more typical of the lands of high northern latitude than is the ice of Greenland.

My work has been in the Antarctic, where there is a large continental land mass around the Pole, the average height of which is so great that, taking it by and large, for area and height I think it is the highest continent in the world. There is more ice there than anywhere else on the Earth's surface. We do not know how high the true land surface reaches above sea-level under the greater portion of the ice-cap; but most of us who have studied it believe there is much rocky land under that ice-continent. It is not nearly so inviting, I am sure, as the Arctic, but it has a great many interesting problems.

Although, at the moment, I would like to change the locus of my projected work for the near future from the Antarctic to the Arctic, I must needs carry on in the former notwithstanding its icy carapace. I can only thank Mr. Stefansson for his extremely interesting lecture.

Dr. H. R. MILL: I can only express my gratification at hearing such a delightful lecture full of humour and of optimism. I am always interested in Stefansson's doings, and ten times more so in hearing him tell how friendly he finds a generally misunderstood environment. He is a striking example of what a man can do and how he can feel under conditions which, in spite of all he says, I cannot help thinking would prove considerably inconvenient to most of us. I thank Mr. Stefansson very heartily indeed for giving me the most instructive and entertaining evening I have had for a long time.

Mr. J. M. WORDIE: There is not much that I can add to what Sir Douglas Mawson and Dr. Mill have said in thanking Mr. Stefansson for his most excellent lecture. My memory goes back to Stefansson's early books and the impression I have of them; and one must say how much one admires him and the wonderful way in which he has travelled in the Arctic More particularly I remember the success with which he worked his dog-teams: after, I think, two years' travel—perhaps he can correct me—he managed to bring back in good condition the very same dog team with which he had started out. That is something which has not yet been so successfully accomplished by British explorers in the Antarctic except, perhaps, in the case of Mr. Joyce, whose account of his great journey in 1916 has just been published; taking, I think, five dogs with him on the long southern journey, Joyce managed to bring back at least four of them after nearly seven months' continuous travel. I must add my thanks to Mr. Stefansson for his excellent lecture.

The PRESIDENT: I cannot remember any lecture which was listened to with more obvious pleasure than the one which we have heard this evening. I think we shall have to correct our geography books in future. We have derived from Mr. Stefansson's lecture a clear idea of the more favourable aspects of the Arctic, and if the unfavourable have been a little glossed over we need not trouble. When people go to the Arctic I imagine they expect the worst, and if they meet anything such as Mr. Stefansson has described, then they are indeed delighted. You will remember that he showed us a land covered with flowers, and told us that the temperature was, I believe, 70°?

Mr. STEFANSSON: The United States Weather Bureau recorded 100° in the shade.

The PRESIDENT: That will give you an idea of the best conditions in the Arctic. At any rate, Mr. Stefansson has given us a picture of that region—and he is perhaps the highest authority on the Canadian Arctic—which we would all do well to study and remember. In the name of the Society I thank him for his lecture.

A JOURNEY IN CENTRAL SIAM: *A paper read at the Evening Meeting of the Society on 27 May 1929, by*

L. J. ROBBINS

MODERN Siam is becoming a reasonably accessible country. Less than fifty years ago rivers and bullock-cart tracks formed practically the only highways, and journeys of a few hundred miles could take weeks and months. Now the railway has changed all this. Lines run south from Bangkok to the Malay States, east to French Indo-China, and north through the central plain to Chieng Mai, so that the most important regions politically and economically are brought within practically a day's reach of the capital. Every year increasing numbers of travellers make use of these facilities to visit Siam, and find that although geographically rather "in the backwash of the China seas" it is a picturesque and fascinating land, with a wise administration and a contented people. In passing I would say that a number of very interesting books on Siam have been written, which deserve to be known to a wide public.*

In spite of the admirable modern development which is taking place, however, there still remain many tracts of wild jungle and hill country, before which progress as yet has had to pause. In particular, there is the western edge of the Korat plateau. This is the least productive and least attractive part of Siam: it is scorched and dry in the hot season, and, through some natural defect in drainage, becomes a swamp in the rains. Consequently communications are extremely difficult, and the population is sparse. At its north-western corner it is bordered by a double range of high hills, running approximately north and south, which enclose a long narrow valley. This

*'Five Years in Siam' (2 vols.), by H. Warrington Smyth; 'Siam' (2 vols.), by W. A. Graham; 'Lotus Land' (Southern Siam), by P. A. Thompson; 'An Asian Arcady' (Northern Siam), by R. S. Le May.

is fairly fertile; a river, the Menam Pasak, flows through it, joining the Menam Chao Bhraya near Ayuthia. There are two towns of some size, Pechabun and Lomsak, on the banks of the Pasak, but the valley is very isolated; it is cut off both from the central plain and from the Korat plateau, and the hills close in at its northern end. Normally the only entrance by land or water is in the south, where the Pasak flows out.

At the beginning of 1928, however, I had the opportunity of going to Lomsak by an unusual route, across the western hills. The cause of the journey was primarily legal. Extra-territoriality for British subjects has officially been abolished in Siam, but until the Siamese law is completely codified, in any case where a British subject is charged with a crime involving a sentence of fifteen years' imprisonment or more, a British judge or legal adviser has to be present at the trial, according to the provisions of the treaties between England and Siam. As it is usually not convenient to bring all the witnesses and other persons concerned to Bangkok, the judge often has to make an arduous journey to a remote local court. In the present instance a Shan from the British Shan States was accused, with two Siamese, of gang robbery with violence in the Lomsak district. The case came under the jurisdiction of Mr. R. W. Aston, of the Siamese Ministry of Justice, and as I had a convenient period of local leave, he asked me to make the journey to Lomsak with him.

There are, of course, many people living up-country in Siam—men in teak firms, survey officials, missionaries—to whom such a trip would be the most everyday occurrence. I think it is H. M. Tomlinson who writes in 'The Sea and the Jungle' of the lonely unrecorded journeys across continents which show our fuss over authentic explorers to be a little overdone. The account given in this paper is in no way remarkable: it merely describes conditions still to be met with in the wilder untamed parts of Siam.

We decided not to go by the known and usual route through Pechabun, which enters the valley from the southern end. This way is uninteresting, and in the past, at any rate, had a bad reputation: Warrington Smyth says of the region, "It is . . . rich in minerals, but cursed by fever and dacoity." We arranged instead to cross directly over the hills on the western side of the valley, starting from Pitsanulok, a provincial town in the central plain about 100 miles due west of Lomsak. According to all report, and as we found out later from villagers, no European had ever made this particular journey before.

I examined the large-scale maps of the Siamese Survey Department, and found that the range had only been roughly surveyed. A few contour lines were shown, indicating heights up to about 5000 feet, but paths, streams, and villages were unmarked. Unfortunately, on such an errand of justice, we could not spare the time to make detailed measurements of heights and distances, but we were able to prepare an adequate sketch-map of the country through which we passed, and mark the positions of the streams on which we depended for drinking-water (see Fig. 2, p. 440).

We left Bangkok on the afternoon of Christmas Day 1927, and arrived at Pitsanulok a little before dawn the following morning. Bearers with torches were waiting, and we made our way to the Government rest-house, which had

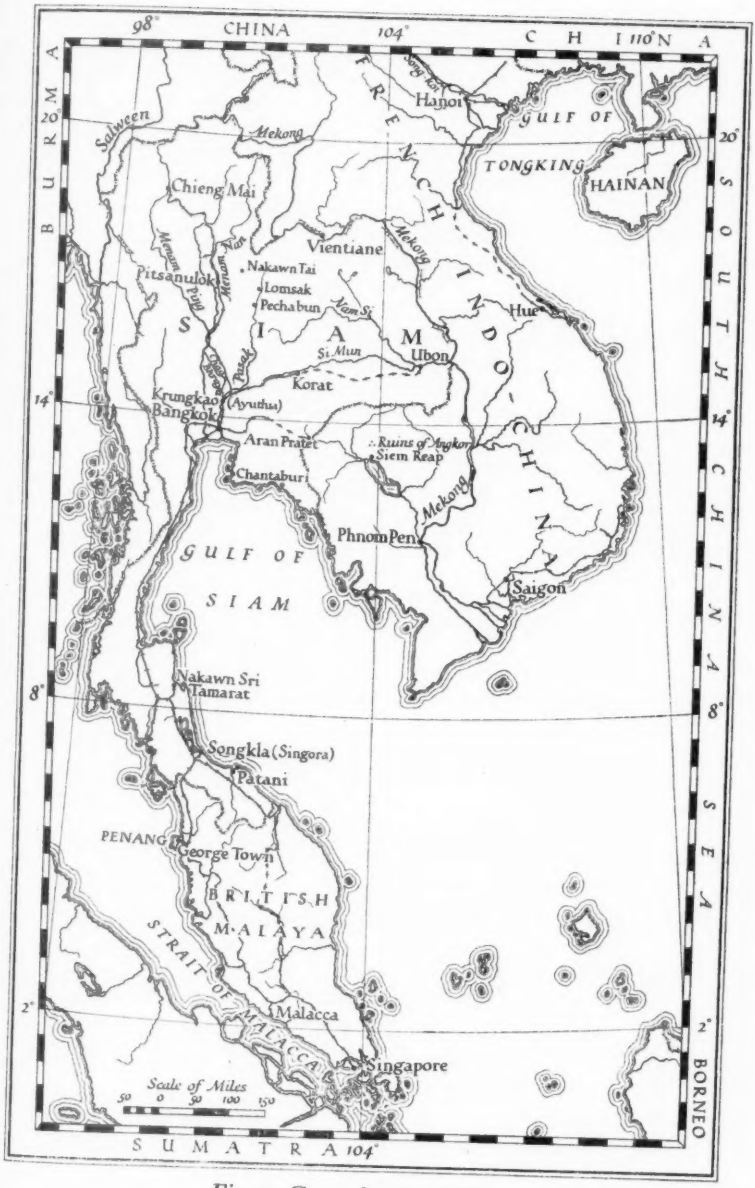


Fig. 1. General map of Siam

been placed at our disposal, while a string of coolies followed behind with our baggage. Pitsanulok is a typical riverside up-country town on the banks of the Menam Nan near its junction with the Menam Chao Bhraya. It was the dry season, and the river, edged with floating houses, was very low, exposing the steep sloping banks. There was sufficient water, however, to float a few teak rafts coming down from the forests in the north to the sawmills at Bangkok. It is not a particularly pleasant town to stay in, being extremely hot, and the mosquitos are ferocious.

The local authorities had been instructed to provide us with twenty-five carriers. We were told that these men, conscripted from among the peasants of the district under the Government Service Corvée arrangements, were waiting for us at the village of Ban Wang Tong,* a day's march from Pitsanulok, so some temporary carriers were secured for this first stage. Probably a smaller number of men would have been sufficient to carry our camp equipment and provisions, but as we were going into unknown and probably difficult country, we thought it better not to overload them. We also took two Chinese "boys," and an Indian cook from Mussoorie who, though an old man, made light work of the stiffest hills. The Governor of Pitsanulok offered to place his riding elephants at our disposal, but as neither he nor his officials knew anything definite concerning the state of our route, we thought it wiser to take horses, and finally obtained two sturdy little Shan ponies. A guide was found to take us part of the way, after which we hoped to rely on local help, since he said that neither he nor any of our carriers had ever crossed to Lomsak before. According to the guide there were two tracks open to us: one direct and unfrequented, the other more circuitous, turning north past the town of Nakawn Tai through a gap in the hills. We chose the former.

Our time in Pitsanulok was spent in feasting, as all the local judges and officials visited us, bringing presents of food and fruit. They thought we ought to be merry for one day at least before our quite unnecessary hardships began.

Early on December 27 we set out. Rice-fields were soon left behind, and we crossed a hot plain of grass and low scrub. The hills which formed our objective were dimly visible far ahead. In one place a marsh remained from the rainy season floods, and over this we were ferried in flat-bottomed boats by some ancient women—thirty people and all the baggage for the admirable sum of one *baht*, or two shillings. At Ban Wang Tong we found our new carriers waiting. We stayed the night in the village *sala*, a simple platform, without walls, the roof being supported on posts. The *sala* is a pleasant and ancient institution in Siamese life; there is one in almost every village throughout the country, usually attached to the local temple, and there any wayfarer can find shelter for the night and a friendly welcome from the priests and villagers.

Ban Wang Tong stands on a stream of considerable size, the Kwee Wang Tong,† a tributary of the Menam Nan. This stream has worn a deep channel in the soft soil, and several large boats left stranded high up on the banks provided a pointed illustration of its magnitude when in flood.

With our new carriers we moved off at dawn. Most of the men carried a short stout bamboo pole (*harb*) across one shoulder with a load at each end.

*Ban = village. †Kwee = tributary.

Waterfall on the Kwee Wang Tong at Ban Pooy

A hut at Ban Pak Hai

Lao hunters setting out to snare jungle fowl (decoy cock in small basket)

Track over southern shoulder of the Khao Kayang

Some of the heavier things, however, were carried on longer poles (*harm*) borne by two men, the load being slung in the middle. Several of the carriers were remarkable for the intelligence they showed in trying to pick out light loads without being detected. Like most Siamese peasants they were a merry crowd. All the time we had them with us they were cheerful, in spite of being taken from their rice-fields at harvest time. Frequent jokes, not all repeatable, passed down the line as they marched in single file, and caused great shouts of laughter.

There were a few small villages near Ban Wang Tong; then the country became broken, and the beginnings of forest appeared. The district was reported to be famous for peacocks. Our path was practically parallel to the course of the Kwee Wang Tong, and we crossed many small tributary streams each running in a deep gully. The latter part of the morning the path became rocky and began to rise through light bamboo jungle. Wayfarers were few; the only ones we met were a solitary gendarme and a party of yellow-robed priests, all armed with jungle knives. The guide reported the possibility of some good duck shooting on the main stream, so I set out with him. He said the place was quite close to our camp, but actually it turned out to be over 4 miles away. It is never safe to take the average Siamese peasant's estimate of either time or distance. There were no duck, but we found a wild and magnificent waterfall. A concave dam of rock, forming almost a perfect semicircle, blocked the river which plunged over thunderously, with a fall of 40 or 50 feet in the middle of the curve. Below it broke up into a dozen swift channels which half a mile away joined again into a single stream flowing through a thickly wooded valley. The river was alive with leaping fish which a solitary fresh-water cormorant leisurely speared from a mid-stream rock.

Track over southern shoulder of the Khao Kayang

The next day the foothills of the range ahead were reached. The track even at this early stage of the journey bore signs of being little used. Over rocks it was a mere smudge, and in some places it was overgrown with tall girth-high grass, very pleasant to pass through in the cool of early morning. According to our usual plan of march, we set off at dawn or before, halting at about ten o'clock for a meal, and then camped for the day a few hours after noon. Evening marches were avoided because of the difficulty of choosing a ground and setting up camp after dark. We averaged between 10 and 15 miles a day.

This day we came to a wide stream, the Huey Yang,* which had to be forded, unfortunately at the same time as a great herd of water-buffaloes was crossing in the opposite direction. Water-buffaloes have been known to take a sudden dislike to white men, but we passed without casualties. On succeeding days we met other herds being driven in for sale at Pitsanulok. The Lao herdsmen were sturdy fellows and well armed, some with bamboo crossbows and others with ancient and dangerous-looking flint-lock guns. Shortly after we came again to the Kwee Wang Tong and camped on its bank, close to the small village of Ban Pak Yang. As we rode in there was a general retirement of the villagers into their huts, high up on poles. We were the first Europeans they had ever seen, and consequently were subjected to much peeping scrutiny at first.

Lao hunters setting out to snare jungle fowl (decoy cock in small basket)

*Huey=stream.

The Laos, who are very closely related to the Siamese, can be divided into two distinct classes, the distinguishing marks being the presence or absence of tattooing on the knees, thighs, and lower parts of the body. The tattooed Laos are called the Lao P'ung Dum, or black-bellied Laos, and occupy the whole of Northern Siam. Those who are without tattooing are known as the white-bellied or Korat Laos, Lao P'ung K'hao, and are found in the eastern and central districts. The people of Ban Pak Yang were of the Korat type. It has been stated that the backwardness and apathy of the Korat Laos may be due to the effect of the climatic conditions under which they live. Certainly these particular villagers were not prepossessing. Disease was rife among them. I noticed several with goitre, and most of the children were marked with chicken-pox. The huts, which numbered about twenty, were of the usual type, having a platform and a single room behind: underneath, sharing the space with pigs and chickens, stood rough hand looms, while on the roofs trays of yellow silkworm cocoons were spread out in the sun. The last of the rice was still being husked by the women in mortars made from hollowed tree-stumps, into which the foot-operated pestles steadily thumped; the big store-bins of plastered wicker were nearly full.

Our beds and awning were pitched on a great flat rock by the edge of the water, and here the village elders, reassured by our men that we were harmless, paid us a visit of inspection. The women were very interested in the contents of our baskets, including the potatoes and soap, which were new to them. The men fingered our guns, and one old *pran* or hunter produced with a deprecating air a fearsome flint-lock blunderbus for comparison. In the evening the girls put flowers in their hair in our honour, long hair piled up in the Lao top-knot, when they came down for water with clusters of globular narrow-necked pots.

It was difficult to extract any definite information from the villagers of Ban Pak Yang about the route ahead. Their radius of knowledge was only a few miles, and they had no curiosity about the world outside. Their life was bound up in the toil of their poor rice-fields, hemmed in by the encroaching jungle. The rainy season cut them off from all communication for months at a time. They showed us flood marks high up on trees growing on the steep river-banks, although then the stream was fairly shallow and running in rapids. There was the low rumble of another waterfall close by. We were over 1000 feet up, but the night was hot, as a great hill just ahead cut us off from the steady north-east wind.

The next morning going due east we passed over a high shoulder of this hill, the Khao Kayang.* It rose up on our left in a long knife-edge crest, thickly wooded on the top: the early sun brought out the colours of the leaves —brilliant reds and yellows on a background of deep green—which disappear in the glare of midday. It was a wearying climb. We began to see that the range of hills was very broad, an upland with many peaks springing from it. The hills were mainly limestone, but there were occasional outcrops of granite and laterite, and the general structure appeared to be markedly foliated. Where patches of laterite occurred, the look of the forest was unmistakable. The common name for this type of forest is "pa mai teng rang," from the

*Khao = hill.

names of the trees "mai teng" (*Shorea obtusa*) and "mai rang" (*Pentacme siamensis*), which are the only species which can grow in laterite. They are always scattered and stunted, and have a strange whitish pallor: being deciduous, they are bare and scorched in the dry season. Very little undergrowth springs from the red earth. We passed one place which was on fire: a low line of flame crackled among the trees, and for miles the air was hazy with smoke.

Finally the track began to drop and we came again to the Kwee Wang Tong, where we camped by the village of Ban Pooy. Here there was another waterfall of great beauty. The river cascaded over a high broken shelf of rock; below, the main stream hurried away through rapids, but on each side there were deep pools in the rock, shaded by trees. The volume of water was still considerable though we were then nearly 3000 feet up. One old villager told us that he had heard that there was a lake up in the hills from which the river was fed, and we were inclined to think that it might be so, but an unforeseen occurrence prevented our following up the course of the river any farther.

There were several canoes made from hollowed-out tree-trunks moored above the fall. That evening we took one and paddled slowly up the river in the brief twilight, past overhanging trees full of noisy parrots. After dinner the *p'hu yai ban* or headman of Ban Pooy came to our camp. He told us that he himself had founded the village some twenty years before. There appears to be some evidence of a definite drift of peasants, *i.e.* the rural population as distinguished from the jungle tribes, into the wilder and remoter parts of the country during the last few decades. This may possibly be due to an increase of population making the valley rice-fields no longer sufficient; or it may be the result of natural expansion and enterprise finding an outlet now that there is satisfactory local government to replace the former system under which the unfortunate provinces were farmed out to rapacious governors.

The next day, New Year's Day 1928, we left the carriers in camp and set out with the headman as guide after *krating*, the Asiatic bison. We pushed through dense bamboo jungle for many hours among fresh tracks, but the beasts themselves eluded us. Siam swarms with game, but the good shooting grounds are so inaccessible and the undergrowth so thick, that little falls to the casual traveller. This day, however, we had one of those rewards that make up for much profitless exertion. Before dawn we had climbed the steep southern slope of the Khao Kayang. There at the top, through a break in the farther hills, a great stretch of country was spread out before us, straight in the eye of the rising sun. The Lomsak valley was hidden in a grey mist through which a thread of river shone: on its opposite side rose the dim shape of the eastern range which borders the Korat plateau. And all about the Khao Kayang were other hills densely wooded to their crests, like a green rolling sea. It was a sudden glimpse of the wild heart of Siam.

On our return we found that the carriers, who had been talking with the villagers during the day, were greatly alarmed at the prospect of the next two or three days' march if we kept to the original track, which went straight ahead from Ban Pooy. They said that it was difficult and overgrown and now abandoned in favour of an easier more roundabout route. Actually, as we discovered from a few muttered words, they were afraid of spirits. As in

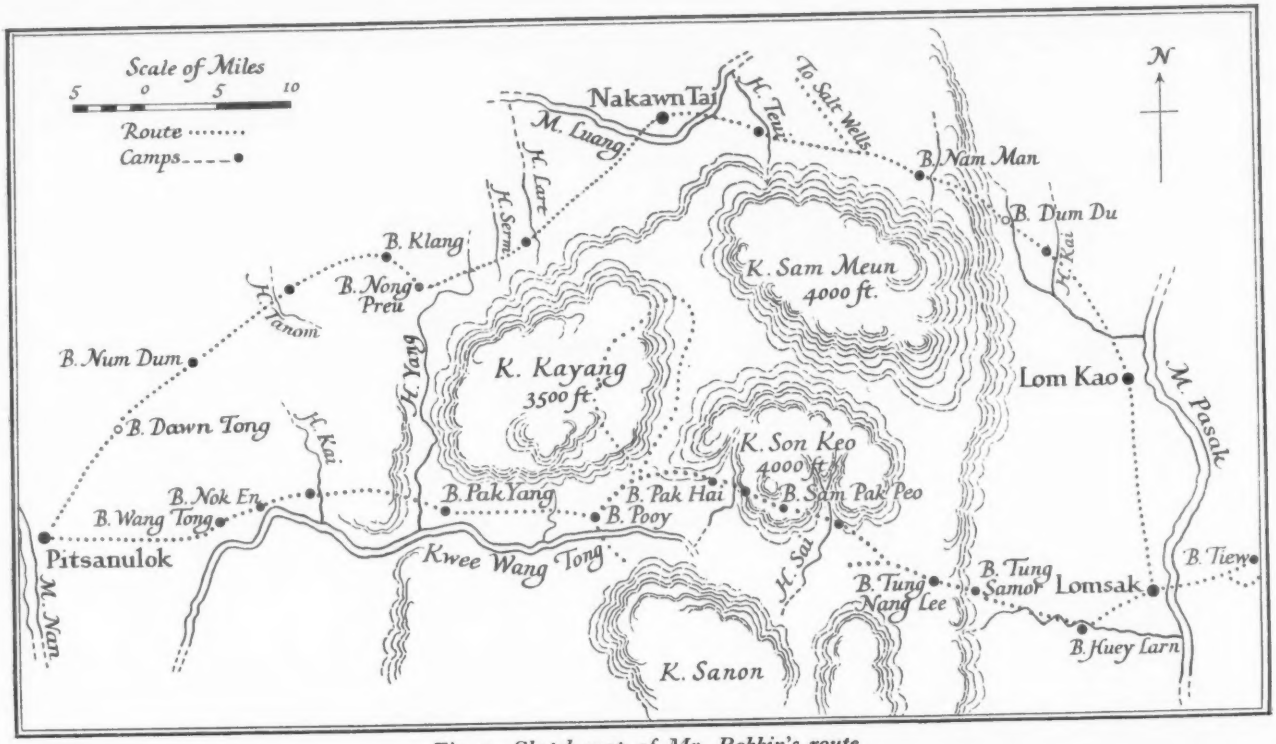


Fig. 2. Sketch-map of Mr. Robbin's route

many other places, the hill in front had acquired a reputation for being haunted, perhaps the result of some long-forgotten tragedy. The fear of evil spirits is still strong among the Lao peasants, who are animists as much as Buddhists: and so, to avoid trouble with the men, we agreed, though with regret, to turn aside.

However, the new route was wild and difficult enough. From Ban Pooy, having hired a fresh guide from that village, we struck north-east for some 6 miles, through a narrow valley, before turning east again. A hot and tiring stretch of laterite forest was encountered before we came to the slopes of the next peak ahead. There we met again the familiar dense tropical evergreen forest. There is a broad belt of evergreen forest which extends from Chantaburi on the coast right up along the western edge of the Korat plateau. South-west of Korat it is known as the Dong P'hya Fai, a place of dreadful repute in Siamese legend, where fever strikes down every traveller.

Many of the trees were enormous, especially the "mai yang" (*Dipterocarpus turbinatus*) and the "mai takien" (*Hopea odorata*). The mixture of species was amazing—red wood (*Xylia xylocarpa*), hardwoods, rosewood, boxwood, ebony, brazilwood, worth fortunes if they could be extracted. In places there were small solitary groves of teak, though the main teak forests lie to the north. We passed a peasant firing an oil-bearing tree. The flames roared up the blackened trunk, whilst at the base, in a cavity cut in the trunk, a thick black resinous oil collected. Our camping-ground, by the edge of a sandy stream, the Huey Sai, was hacked out of thick undergrowth and surrounded by a primeval tangle of creepers. All round the jungle came down like a wall. There were fresh tiger tracks in the bed of the stream. Here we met a party of Lao hunters on their way to snare jungle fowl. They had with them a tame decoy cock, and a large curiously shaped basket in which to place the victims. The method of the hunters is to loose the decoy on a string, and to catch dextrously in a net the birds which approach when he crows.

Rare and solitary villages existed at a few places where there was a natural thinning of the forest. The next day we passed such a village with about a dozen huts. A quantity of coarse rank tobacco was drying in the sun, and some deer-hides were being cured. We had not been able to shoot any jungle fowl for some days, so we tried to buy a few chicken; but the shy villagers would not sell any, since the money we offered was of little use to them. We halted by a rocky stream, after crossing by a single slippery tree-trunk. There was a lively company of gibbons in a high tree, and their strange rising cries echoed through the forest. A greater hornbill croaked in the distance. The monkeys moved away after inspecting us, crashing among the branches, each moving precisely in the track of his predecessor. Later in the day we passed over the brow of the hill and came to jungle thicker than any we had found before. The track led up precipitous slopes and down into damp gullies where tree ferns grow. For hours we travelled in a moist green twilight without a glimpse of the sky. Below was matted undergrowth from which the huge tree-trunks shot up 100 feet and more before the branches began. Supported far above on these straight bare columns was a great arch of foliage where doubtless masses of orchids flamed, but from below there was no colour to break the monotonous green. Great festoons of lianas hung down from the

Fig. 2. Sketch-map of Mr. Robbin's route

high branches. The track was cumbered with trees which had fallen in tremendous ruin. There were enormous interlocked clumps of giant bamboo, their massive stems crossing at all angles. No birds sang, and a brooding silence hemmed us in, which the noise of our passage seemed only to accentuate. In places a musty smell lingered in the air where some animal had recently passed.

The next day the going became a little easier, and we began to descend. We came to a side track leading to a Meao village. The Meao tribe have been described in detail by McCarthy and other travellers. They are considered to be of Tibeto-Burman stock, and have slowly drifted southwards into Siam. They are remarkable in that they live in isolated communities on the highest hilltops they can find, cultivating principally rice, tobacco and opium. When the earth of the upper hill slopes begins to show signs of exhaustion, the whole village moves to a new and vacant hilltop. Their standard of life is far above that of the surrounding peasantry. They have a distinctive dress suitable to the cool climate of the hilltops, the men wearing black trousers, a long coat, and a turban; while the women wear a short pleated skirt with an embroidered jacket and a coloured turban. Their houses, unlike the light Siamese pile-built huts, are strongly constructed with log or mud walls and stone floors. The southward drift of the Meaos is well known, but I believe this region is about as far south as they have actually been met with before.

Farther on a deserted village was encountered, only the stark house posts remaining, standing up mournfully in a wilderness of undergrowth. Our guide said that many years ago it had been scourged by an epidemic of small-pox, after which the survivors had fled. The surrounding land, once cultivated, was thick with strongly growing stubborn weeds. Then quite suddenly we emerged into an upland park-like grass plain edged with groves of tall pine trees. The day's march had been very short, but this was such a refreshing change after the jungle that we made camp at once, and enjoyed a fire of pine logs at night. The sudden change in the character of the forest here was remarkable. Probably it can be accounted for by the fact that this eastern side of the range falls very steeply some 4000 feet into the flat Lomsak valley, and thereby is much exposed to the cool wind of the north-east monsoon, so that it is possible for the trees of a temperate climate to grow here. The hills stand up like a wall, in contrast to the western side, where the slope is gradual.

From here onwards progress was rather a scramble. We encountered many streams running swiftly in rocky channels. Some of them were spanned by single-plank bridges, over which the carriers went confidently; we, however, with the ponies were forced to negotiate the steep banks. Villages began to appear and the track became well worn. Below us we had occasional glimpses of the valley, while behind we could see the high hills we had crossed with early morning clouds hiding their peaks. The path became entangled with a winding stream, the Huey Larn. First one bank had to be used and then the other, and we must have crossed and recrossed twenty times at intervals of a few hundred yards. Finally we came to a big prosperous village, Ban Huey Larn, very different from the jungle villages, where we put up in a *sala* attached to a small temple.

We were the centre of interest to an attentive crowd which closely watched all our actions and doubtless came to some strange conclusions. For instance, as we were sitting on the low wall of the temple compound drinking our evening *stengahs* the *p'hu yai ban* came along with our guide to be introduced. Just then one of us happened to upset a glass in putting it down; the headman at once turned to the guide, and we heard him whisper with obvious envy, "Isn't he lucky? the *nai* is drunk." At night the whole population gathered round the *sala*, and many who were sick made trusting demands on our slender stock of medicines. Then a number of *k'hen* were produced. The *k'hen* is the Lao reed organ made from a double row of stopped reed pipes opening into a common mouthpiece. The local musicians played us a number of plaintive Lao airs with strange attractive harmonies.

The next day, January 6, after a few miles of open forest and grassland where cattle were grazing, we descended into the flat Lomsak valley. Turning a little to the north-east we crossed a wide stretch of rice-fields and finally arrived at Lomsak, where we stayed in the guest house of the local "Wild Tigers"—a territorial force instituted by the late King of Siam, Rama VI.

Lomsak proved to be a typical sleepy up-country town, consisting of a few houses, the usual Government buildings, a conspicuous prison, and a temple with many priests. The only commercial enterprise of any sort was provided by the ubiquitous Chinese. The main street led past the usual covered market to the banks of the Pasak. The river had once been spanned by a fine wooden bridge, but a sudden flood had carried most of this away some two years previously. With rather typical lethargy the local authorities had made no attempts at rebuilding, but instead had merely thrown a few unstable planks across the river. Large numbers of cargo boats were waiting for the rains to begin, in order to make the long journey down to Bangkok. The district is fertile and might be very considerably developed in the way of rice growing and cattle breeding, were communications better. This, in fact, has been realized by the Government, and a branch of the Korat railway line to Pechabun is now being surveyed. The State Railways, under the able control of H.R.H. Prince Purachatra of Kambaengbejra, have brought considerable prosperity to the agricultural districts along their routes. Up till now, however, the railways have been developed at the expense of road communications, owing, I believe, to the feeling that in time road traffic might prove to be a serious competitor to railway traffic. But it is doubtful whether Siam can ever have a network of railways owing to the natural difficulties of the country. The main function of the railway would appear to be that of putting the Chieng Mai district in the north and the Malay States in the south in direct communication with Bangkok; while roads should be the local feeders of the railway. A considerable mileage has been constructed near the border of the Federated Malay States, but roads and more roads are sorely needed in the north and east if the outlying regions are ever to be developed. There the bulk of the local traffic is still carried by rivers which are unnavigable in the dry season because of rapids. But even now the motor traffic on the few roads in the neighbourhood of provincial towns is extraordinary; cheap American cars are to be seen everywhere; and in the dry season, enterprising individuals, usually Chinese, run village to village car and lorry services across

the rice-fields and along bullock-cart tracks, to the no small discomfort of the passengers.

The trial at Lomsak lasted four days, and was only remarkable for the incredible stupidity of the witnesses. One evening we received a deputation of the leading British Shans at Lomsak, who said that it was thirty years since a British Consular officer had visited the district, and consequently there were many not registered as British subjects. They asked us to call the attention of the Legation at Bangkok to this, and I heard a short time ago that Lomsak had been included in a recent Consular tour of Eastern Siam.

When the trial was over, we decided to make the return journey by way of Nakawn Tai. The first part of the route, we were told, formed an official high-road and promised interesting and unusual glimpses of local traffic and wayfarers. The track however proved to be almost as difficult as that of the outward route, although it crossed a lower saddle of the hills.

We left Lomsak on January 12 by motor lorry, and went north some 15 miles along a bumpy local road to the old town of Lomsak, called Lom Kao, now only an unimportant village. The valley here was not more than about 10 miles wide, and across the rice-fields the hills on either side could be seen. Among the fields were many flame-of-the-forest trees in bloom. At Lom Kao we took on a fresh set of carriers, since our first men had had to hurry back to the Pitsanulok district immediately after our arrival at Lomsak, in order to finish harvesting their rice. When they were paid off each received seven *baht*, just over thirteen shillings. Some we noticed bought cloth and other articles in the town, and some got drunk.

In the neighbourhood of Lom Kao there are ruins of some ancient temples. Over most of Siam there are ruins which form a most invaluable historical record. When Ayuthia, the old capital of Siam, was sacked and burned by the Burmese in 1767, practically all the state documents and records of the kingdom were destroyed; consequently many points of Siamese history have had to be settled by archaeological research. In the south there are the remains from the days of the very early Indian settlers, including the famous *stupa* at P'hra Patom. Then there are the ruins dating from the eighth century kingdom of Sri-vichaya; in particular those which Professor Cœdès, of the Siamese National Institute, has recently excavated at Pong Tuk. Before Siam really became a kingdom, during the so-called Lopburi period, the Siamese or Tai people were under the domination of the mighty Cambodian empire, and in Eastern Siam there are still traces of that marvellous and fantastic Khmer architecture which came to its most brilliant achievement at Angkor. Later, in the fourteenth century, Siam broke free from Cambodia, and the kingdom of Sukodaya was born—the cradle of the Siamese race. From that time a characteristic temple architecture grew up, reflecting those earlier influences. The ruins still existing, with their various styles and geographical distribution, form a fascinating picture of the growth and development of Siam and the Siamese.

Our track from Lom Kao turned north-west and soon reached the hills at a place where great boulders of granite were frequent. We met many parties of northern Laos dressed in the usual blue coat and short trousers, both men and women carrying heavy loads. In places the villagers had set up

Stunted forest on laterite east of Nakawn Tai

Camp in jungle by the Huey Sai

The Khao Sam Meun, looking west from Lom Kao

Lao women of Ban Pak Yang

little provision shops, platforms of bamboo roofed over with branches, to sell rice and curry and betel, and these wayside restaurants did a profitable business with our big party. The day was extremely hot, and we were glad to camp after hours of steady climbing. The next morning our guide warned us that halts must be chosen with discretion, since there were long stretches not crossed by any streams. This was true of the greater part of the way, in marked contrast to the outward route, where streams occurred every few miles.

Salt appeared to be the principal commodity carried along the track, coming from the famous salt deposits near Nakawn Tai. The salt is found some 40 feet below the surface, and is extracted by brine wells. Many carriers passed us with heavy loads of salt in wicker baskets, and we overtook a long train of pack-cattle, more than a hundred head, going to the wells. The "clock-clock" of the bronze bells they carry, faint in the distance, then gradually growing clearer, is a charming and unforgettable sound. We also met a Siamese Treasury official travelling in state, with his wives and several sons and daughters riding ponies, and a rabble of servants and baggage behind. At this place the track flattened out into a small rocky plateau, where the forest was thin, but close ahead was a thickly wooded hill, the Khao Sam Meun, which we mounted the following day.

We saw many droves of pigs being driven over the hills to the railway line. At night they were coralled in rough pens of bamboo, and we noticed that the herdsmen were careful to put up white paper symbols to scare away the spirits. All the peasants we met were very friendly. Europeans are generally respected, and many have travelled alone and on foot through the wildest parts of Siam. But while their lives have been safe, their belongings have sometimes proved a source of temptation. For example, none of the diaries, manuscripts, and photographic negatives of Carl Roebelen, the great orchid collector who died in the jungle near Vientiane some two years ago, were ever recovered.

The Khao Sam Meun rose steeply, and on this eastern face of it there was a belt of dense and damp jungle. "Spanish beards" of moss hung down from the upper branches of the tall trees. Then over the brow the aspect of the country changed completely; there was a broad valley covered with thick high elephant grass, and we obtained a fine view of the surrounding peaks many miles away. The carriers said that the place was teeming with game. Farther on the valley-bed changed to laterite, with characteristic stunted white trees growing in the red earth. We marched on and on interminably through the hot afternoon without coming to a stream. We carried practically no water with us, and so had to continue. The glare from the laterite was most unpleasant, and the men grew very tired. At last the laterite vegetation gave way to green forest, and a watercourse appeared with a thin trickle of water, where we camped. The crevices in the rocks by the stream were alive with tiny frogs, which the men caught and ate, considering them a great delicacy. When we arrived we found a party of Chieng Mai Laos halted there. They were tall, finely built fellows, and carried with ease enormous bales of cloth.

Early next morning, after passing through a stretch of light bamboo jungle, we dropped down to the rice-fields of Nakawn Tai. A river of considerable

size had to be crossed, and there was no bridge. One of our men waded across and found that the water ran neck-deep. But fortunately a wet passage was avoided. Two small bamboo rafts came past, and these were commandeered to ferry us over. The town was small and uninteresting, reflecting the poverty of the district, where the peasants find it difficult to wring a living from the soil. The day was a Sunday, an official holiday in Siam, and we were told that all the local government servants were out hunting.

Beyond Nakawn Tai we passed several small villages, where every one was busy threshing rice. From here onwards the track became difficult, and showed signs of being little used. It began to bend round towards the south-west, and we came again to the Khao Kayang, the other side of which we had crossed on the outward journey. The jungle here was immensely thick, and steaming with moisture. In places the streams were choked with mud at the bottom of deep gullies. Several times we heard the croak of the greater hornbill, and once three flew over ponderously, with creaking wings. They are huge ungainly long-necked birds, with large yellow bills and broad black angular wings barred on the underside with yellow. The rare Argus pheasant is also known in this district, and we met some Laos who had trapped a number with nets.

The western slope of the Khao Kayang broke up into rolling foothills, from which we branched off a few miles to the village of Ban Klang, where we proposed to camp for a day or two's shooting. The village lay at the end of a small valley of rice-fields completely surrounded by forest. We made our camp pleasantly on a closely cropped grass slope by a little wooden temple. As in many of the poorer villages, priests did not live there permanently, but only paid periodic visits to it. The villagers were busily occupied with rice threshing. That night on the mud threshing-floor seven water-buffaloes, tethered to a central post, slowly circled round to stamp out the rice from the ears by the light of flaming torches, encouraged by the shouts of numerous children. On a tall pole was a propitiatory gift to the spirits. The next morning winnowing began. The rice stalks were cleared from the threshing-floor, leaving a pile of yellow grain. The men with large shovels pitched it into the air, while as it fell on to another heap the women fanned away the dust with big trays. There was a pleasing rhythm about the process, and all those taking part wore their brightest garments to celebrate their deliverance from the toil of the rice-fields.

The village hunter took us out to a promising place for shooting, a small depression of saline earth where we saw footprints of wild elephant and many tracks of sambur and barking deer. A platform was built into a neighbouring tree. But it was never used: Aston went down with fever that night, and we had to hurry back over the remaining few miles to Pitsanulok. Before leaving, however, we got some of the jungle fowl that came down to the edge of the rice-fields, and also shot hares in the glades of the forest by the light of lanterns.

The village doctor or medicine man came at his own invitation to advise on the fever. He ascribed it to an evil wind in the head, and proposed by a system of massage to entice this wind to the patient's toes, from whence, after a small incision, it could be ejected by suitable incantations. Needless to say he was not allowed to put his cure into operation.

This was practically the end of our journey. The country from here onwards was flat and cultivated. A litter was improvised, and by a double march we covered 20 miles the next day, camping late in the evening. At the village of Ban Dawn Tong on January 23, we fortunately encountered a cross rice-field lorry service by which the invalid was soon transported to Pitsanulok, and placed in the care of an American missionary there.

So we finished; not without regrets, for there is a lasting fascination in the untouched jungle. Perhaps in future years the Lomsak valley may thrive and develop, but I hope the hills which enclose it will always remain inviolate and remote.

DISCUSSION

Before the paper the PRESIDENT (Colonel Sir CHARLES CLOSE) said: The lecturer to-night is Mr. L. J. Robbins, who was for a few years in the Ministry of Education of Siam. Whilst he was in the Siamese Government service Mr. Robbins took the opportunity of accompanying a legal officer up into a part of Siam which, I think, was previously unvisited by Europeans—at any rate, it was very little known. Mr. Robbins has come before us to describe that part of Siam. We shall be interested to hear what he has to say, and I will now ask him to commence his lecture.

Mr. Robbins then read the paper printed above, and a discussion followed.

The PRESIDENT: We are honoured to-night by the presence of His Royal Highness Prince Purachatra, who is now Minister of Communications in Siam. He has promised to say a few words on the subject of the lecture, and I ask him now to address us.

His Royal Highness PRINCE PURACHATRA: Not being content with the story of a gallant young Englishman as to how he travelled over tracks which are not usually traversed in Siam, the President has asked me to address a few words to you in order to introduce something more Siamese to this audience. Whether it is Mr. Robbins or myself, I do not know, but I think we have brought the Siamese climate here to-night—even I find it exceedingly hot. I hope, therefore, you will excuse any shortcomings on my part because you have heard Mr. Robbins say that owing to climatic conditions the Siamese are not always energetic.

First I should like to say that, in spite of the endeavours of writers to make Siam known, very few people have known it until recently principally because of economic reasons. That is to say, our exports do not touch you directly. We mostly export rice and teak wood in the raw state; they are put through various processes before they are brought before you, and you may not then realize that they are the products of Siam. What has probably made Siam more widely known is the rich growth of the jungle against whose invasion we are continuously struggling.

As to communications, which Mr. Robbins has said are in a somewhat backward state, perhaps I may be excused if I make an apologia. I have been in charge of the communications for the last twelve years, and during that time we have tried to follow up what we can of the newer civilization. Hitherto the only forms of travel had been mainly by the rivers in the plains, and by mules or carts in the mountainous parts. Newer forms of locomotion have come to us in the shape of automobiles as well as railways. I should like to take this opportunity of saying that there is no fear of roads competing with the railways in Siam, because with us neither roads nor railways have existed in the past. We are therefore at perfect liberty to construct either road or rail. As the Government has to pay for the construction of both means of transport it does not, for

economic reasons, build roads parallel to the railways unless or until transport requirements justify such a course. The line of communication Mr. Robbins has mentioned as being rail up the Lomsak valley is really to be a road, and if you wish to traverse the virgin country he has been through you should hurry up, because in three years it will be possible to get to Lomsak over that road in a few hours instead of days.

We are now actively concerned in building up roads within the limits of our purse. Our country is very small, and we have tried to aim at independent finance without unduly harnessing the taxpayers by large loans; we are trying to finance developments within our competence to pay. You will have heard what Mr. Robbins said with regard to the backwardness of the people in the villages. Now, if you start off giving them easy means of travel without first letting them know what they have to produce and the quality of their produce, you will facilitate their exploitation by middlemen and there will not be proper profit to the people at large. That risk had to be very carefully weighed and the ground carefully prepared before the design for any new communications was approved. Again, you have heard what Mr. Robbins said as to the Siamese being a home-loving people. They do not travel very much. Careful statistics have been got out and a census taken. When I took over the railways twelve years ago a strip along a line of about 100 kilometres on each side was taken as an indication of the population capable of using the railways. At that time the travelling public on the railways, according to the census of population along the line, was 0·43 per cent. After twelve years of that administration and extension of lines from 900 kilometres to 2500 kilometres, the travelling population is 0·63 per cent. only! Take our neighbour in the south. In the Federated Malay States the travelling population is 113 per cent. When we design communications we have to educate or eradicate our people from that home-loving habit; to internationalize them, as it were. I am sorry to have to make this apologia, but I thought it well to give you the reasons why the communication policy has to be carried out very carefully indeed. I have also to be careful of my reputation as a member of the British Institute of Transport. I think the policy of the Government has been cautious and careful and within the means at their disposal for development.

Taking Siam as a whole, it is practically the same size as France. It is 500,000 square kilometres, with a population of 10,000,000 only. Therefore—well, you may say it is ingrained in us not to be energetic but also, even at this time, I feel that, for the safety of all concerned, including the morals and education of the people, we must hasten slowly, and I feel sure that with that in mind we shall still retain our independence in the future as our forefathers have kept it for us in the past.

Apart from local considerations, we have also to bear in mind international communications. You have heard Mr. Robbins say quite rightly, and it is the saying of many, that Siam is geographically in the backwash of the China seas. Yes, I agree so far as ocean routes are concerned. But when you consider Siam from the point of view of land communications, is it in the backwaters? We can radiate out to Burma, to Indo-China, to Singapore as well as to British Malaya, and communications are being radiated out to those places.

We are also in the centre of air communications because every flight that goes to the East—towards China, Japan and Australia—passes over Siam, which is in the main air route. This will eventually to a very great extent bring Siam into prominence and into line with others in the development of her land and aerial communications.

I am very glad to have been given an opportunity of addressing such a distinguished body as those present to-night, and I am sure that I shall not be tres-

passing on the President's province when I say I have listened to Mr. Robbins's lecture with a great deal of pleasure, and that when the vote of thanks is given I shall heartily support it.

Mr. W. A. GRAHAM: Coming after His Royal Highness there remains little for me to say with regard to Siamese aspirations and economics. I think His Royal Highness has pretty fairly dealt with those topics, and I will therefore confine myself to Mr. Robbins and his excellent paper.

It has been an immense pleasure to me to listen to this very interesting lecture and to see the beautiful pictures that Mr. Robbins has shown, bringing back to my mind, as they do, the great pleasures and also the trials of travel through those very parts of Siam. For, although our lecturer has said that few or no Europeans had ever been before along the route that he describes, my wife and I rode over a part of it about fifteen years ago. Some of the views that Mr. Robbins has shown to-night are of places we visited, and I regret very much that, not being, shall I say, a very methodical or energetic person, I took no photographs and kept no record, other than my official diaries, of my journey.

We set out from the railway at Utaradit, some hundred miles farther north than Pitsanulok, Mr. Robbins' starting-point. We went due east to Dansai (the French frontier); thence south to Nakawn Tai, and then over Khao Sam Meun and down to Lom Kao and so to Lomsak along Mr. Robbins' return route. From Lomsak we followed the river Pasak, some 150 miles, rejoining the railway at Keng Koi—but that is another story.

This Pasak river is important to Siam as being the first stream to be tapped by the organized system of irrigation now being carried out at considerable expense, and hitherto with much success, by the Siamese Government. Originally constructed by irrigation experts engaged from India, the Pasak system is now administered by Siamese irrigation engineers, much to the credit both of the British experts who taught them and of the officers themselves.

The lecturer's descriptions of Lomsak and Lom Kao were not perhaps very extensive. I stayed in both those towns for some days and was very much struck by many peculiarities of the neighbourhood. Lom Kao, which has long been of secondary importance to Lomsak, lies in a beautiful enclosed valley, green all the year round and watered by many streams. It struck me so strongly as an excellent cattle-grazing country that I was moved to advise the Government to introduce a number of well-bred Siamese stud ponies there, to breed with the local supply of mares and thus obtain a native pony suitable for military and other purposes, avoiding the mistake made by Burma of crossing the native blood with foreign. The scheme was duly started but was not much of a success, the locality proving too remote for effective administration. But the place remains the ideal grazing-ground of the country and, I feel sure, will develop some day when His Royal Highness Prince Purachatra has carried through his projected roads and has opened up this part of Siam as he intends to do.

His Royal Highness has very modestly given you to understand that the development of Siam is a very slow process. While agreeing that the country must go cautiously if it wishes to avoid the sudden inrush of a foreign population that may swamp the Siamese altogether, I must say that this policy has not prevented the making of very big strides by Siam along the paths of development during the last thirty years or so; and that none have done more towards this progress than Prince Purachatra himself, who has put in an enormous amount of work in his particular department.

Lomsak itself is an interesting little town, once remarkable as a gold-mining centre. There is a little valley some 4 miles from the market-place, where at one time there was something in the nature of a gold rush. It had passed when I

visited the neighbourhood, but has left interesting and instructive remains. On entering the little valley with its steep banks, one finds on a small promontory a number of tiny huts, from 150 to 200, and these are the abodes made by the gold-miners for the tutelary spirit that accompanied each one of them to the mines; spirits that had to be duly propitiated before successful gold washings could be expected. With ghostly assistance much gold was obtained. The tidings spread, and a party of Europeans came and explored and finally obtained a lease from the Government to mine the whole place. Expensive machinery was introduced and shafts were sunk high up in the hills, but the spirits were contrary, little gold was found, and finally a malignant fever killed off the whole staff, which put an end to the gold rush. Abandoned boilers, stamps and pumps, minus all movable parts, are still visible there, sad monuments to this lost endeavour.

Lomsak is of some slight importance in Siamese history. It was, until about one hundred years ago, a small semi-independent principality paying a nominal tribute to Siam. The people were prosperous, and their rulers were a dynasty of the usual somewhat tyrannous despots who, as many despots have done, ran their country very well. But the last of them got into trouble, being foolish enough to transfer his allegiance from Siam to Burma during one of the incursions of the latter into the Lao States. A punitive expedition was sent from Bangkok, the gentleman's head was taken off, and the dynasty came to an end. Now Lomsak is an orderly, self-respecting district administered by a Siamese governor.

Mining is not the only way money can be lost in Siamese jungles. Mr. Robbins has referred to the large herds of pig that are driven down from the far north to the railway through the jungle, and to the fact that they are guided by rough fences running sometimes for many miles through the forest. I had a friend once who was a man of adventurous spirit. He had a clerical job in Bangkok, but longed for an exciting life and the chance of riches. So he realized his small capital and went to the far north of Siam and invested the lot in a large herd of pigs. He started a long way from railhead and calculated that, in view of the many months to be passed in the jungle, by the ordinary processes of nature he should have at the end of his journey many more pigs than he had when he started. He also calculated the very big profits he would make. But somehow things went wrong. The ordinary processes of nature did not seem to work, while the man had not allowed enough for sickness, thieves, carnivorous animals, and so forth. Also his fencing may have been defective, and, what with one thing and another, he reached railhead at last quite tired out and with only one pig left.

I cannot sit down without repeating how very much this lecture appeals to me as coming from Siam. I hope others have enjoyed it as much as I have.

The PRESIDENT: First of all, you will want me to thank His Royal Highness, Prince Purachatra for honouring us with his presence to-night and for the most admirable speech he delivered. It is a real pleasure to me personally to meet His Royal Highness again. We served together at Chatham twenty-seven years ago and I had not met him since. I am delighted to see him here and to hear of the very admirable work he is doing for his country.

Then we want to thank the lecturer for the account he has given us of his journey in a part of Siam which, although perhaps not altogether unvisited by Europeans, has not often been traversed before. We also thank Mr. Robbins for the beautiful coloured slides he showed, which reminded me of the neighbouring Shan States. I think he has given us a very interesting account of the country, and we congratulate him not only on the journey and the lecture, but also on the admirable slides which he has shown us.

THE GLACIAL CONDITIONS AND QUATERNARY HISTORY OF NORTH-EAST LAND

K. S. SANDFORD

1. *Introduction*

NORTH-EAST Land for its size, about that of Wales, presents a remarkable number of glacial characters and displays in miniature many of the features of a continental ice-sheet. From the traveller's point of view it is regrettably thorough in this respect, since in its small area it concentrates a wide range of difficult obstacles. If the island were easily accessible it would prove a valuable region for students of glaciology and of glacial meteorology, but accessibility is certainly not among its attributes. This is reflected in the history of its exploration, which has already been described in the *Journal* and elsewhere.* In the present paper I propose to discuss only the glacial condition and history of the island, leaving a description of its important meteorological phenomena and of its geological structure to papers already published.†

For my association with the island I have to thank the Oxford University Arctic Expedition of 1924, since I was selected as its geologist and as a member of one of the sledging parties. I am particularly indebted to George Binney, Hugh Clutterbuck, R. A. Frazer, and to the members of the other sledging parties who supplied me with notes and information on our return to the Base Camp. It is inevitable that most of my examples should be drawn from what I saw with my own eyes as a member of the central sledging party. I have endeavoured, however, to incorporate all the information given me by the other parties, and my gratitude is especially due to R. A. Frazer and W. B. Carslake for reading and annotating the original manuscript of this paper.

With regard to the illustration of the paper, I have endeavoured to avoid repeating photographs already used in other connections in publications by members of the expedition. References to these will be found in the text.

2. *Outline of the Geology of North-East Land*

Since we shall find that the subglacial topography and geology have an all-important bearing on the condition of the ice-sheet, brief reference must be made to the subject. It is dealt with more fully elsewhere.‡

The northern part of the island consists of granite, gneiss, schist, quartzites and other rocks, most of them probably of Older Palaeozoic age, which make up a varied and rugged topography. To a considerable extent this has been rounded and smoothed, but the country is nevertheless varied and hilly, the

*A. E. Nordenskiöld, 'Arctic Voyages,' pp. 219 *et seq.* London: Macmillan. 1879.
F. G. Binney, "The Oxford University Arctic Expedition (1924)," *Geogr. Jour.*, vol. 66, 1925, pp. 9 *et seq.*, with appendices *ibid.*, pp. 111 *et seq.*
F. G. Binney, 'With Seaplane and Sledge in the Arctic.' London: Hutchinson. 1925.

†K. S. Sandford, "Summer in North-East Land, 1924; The Climate and Surface Changes," *Geogr. Jour.*, vol. 68, 1926, pp. 200–225; and "The Geology of North-East Land, Spitsbergen," *Quart. Jour. Geol. Soc.*, vol. lxxxii. (1928), pp. 615–665.

‡K. S. Sandford, *Geogr. Jour.*, vol. 66, 1925, pp. 114 *et seq.*; and *Quart. Jour. Geol. Soc., loc. cit.* Detailed maps will also be found in these publications.

exposed rock attaining its greatest heights in this region.* The central region, north of Wahlenberg Bay, is an elevated plane of marine denudation upon which rest outliers of Carboniferous and Permo-Carboniferous rocks, lying unconformably upon sedimentary rocks of Older Palaeozoic age. The younger group of strata is horizontal and capped by an important dolerite sill probably of Cretaceous age, at about 800 feet above sea-level. The subglacial topography of this region is probably an upland plain, sloping slightly southward, and bounded on the south by a number of high bastions between which deep and narrow valleys make their way to the northern shore of Wahlenberg Bay.

Wahlenberg Bay is a deep, straight-sided fjord running east and west into the heart of the island. It receives the drainage of the whole of the interior. On its south side the rocks which form outliers on the north shore present a magnificent scarp which follows their strike and attains a height of about 1100 feet (the sill being locally some 150 feet thick). Only in a few places do small and steeply sloping valleys breach the great cliff and allow insignificant glaciers to reach the shore, though south-east of the head of the bay more broken country may exist. Here, however, the scarp is overwhelmed by the land-ice and lost to view. From this scarp the rocks, though virtually horizontal, dip slightly towards the south or south-south-east, and in the south-east corner Permian give place to Triassic and older Secondary strata. The subglacial topography is probably a monotonous plateau in which the only features likely to occur are small detached hills and ridges of dolerite. It is difficult to estimate to what extent the plateau is dissected by valleys.

Along the east coast the whole of the formations are submerged beneath the land-ice and are below sea-level, with the exception of a knob of granite which appears at Isis Point.

3. *Contour of the Ice-sheet*

The glacial covering may be divided into Island Ice and Highland Ice,† and for convenience I shall refer to the former as the Dome. Observations have led me to believe that there are three domes, each of rather limited area. Of these, two are in the northern part of the island and are separated by a north-south depression marking a rock-valley of which the southern end is free of ice. The third lies on the south side of Wahlenberg Bay, and a high saddle runs northward from it, between the head of the bay and the east coast. Of these only the north-westerly has been examined in any detail. It was crossed by our northern party in 1924, while the central party traversed its southern flank. The north-easterly dome was crossed by Nordenskiöld in 1873, and the saddle in 1924 by our southern party : the southern dome is unexplored.

(*a*) *The Island Ice or Dome.*—This region, as we saw it in 1924, simulates on a small scale the more elevated central regions of a continental ice-sheet. Its surface is featureless and convex, and is not broken by great crevasses.

*530 metres, a little south of North Cape, see Map in G. De Geer, 'Miss. Suédoise. Mesure d'un Arc d'Méridien au Spitzberg,' t. II. s. ix, 1923.

†The terminology used in this paper is based on C. S. Wright and R. E. Priestley, *Glaciology*, 'British *Terra Nova* Antarctic Expedition, 1910–1913.' London: Harrison. 1922. See also J. M. Wordie, "Present-Day Conditions in Spitsbergen," *Geogr. Jour.*, vol. 58, 1921, p. 25.

Flanks of Dome after three days' blizzard: Mount Idun carapace on left *Phot. R. A. Frazer*

Rolling surface of Highland Ice, with crevasses, after melting: Mount Idun in centre *Phot. R. A. Frazer*

Floating end of glacier, east of Mount Idun — *Phot. E. Relf*

Edge of Highland Ice at sledging base, ice well stratified — *Phot. R. A. Frazer*

Phot. R. A. Fraser

Edge of Highland Ice at sledging base, ice well stratified

The central party found its flanks swept clear of snow by blizzards, the full force of which was felt as we worked along the lower slopes. Its surface here consisted chiefly of hard granular ice, torn, abraded, and polished by the winds. The only remaining snow patches had been hardened by slight melting and subsequent freezing, and welded immovably to the underlying blue ice. A certain amount of melting goes on here in midsummer, of which flowing water in cracks on the flank of the dome bore evidence. Soft snow does not lie long. In early spring, however, A. E. Nordenskiöld (1873) was seriously hampered by clouds of fine, dry, and powdery snow which were raised from the surface in blinding clouds by comparatively light winds.

It should be noted, as W. B. Carslake has pointed out to me, that the northern party found bare ice only near the edge of the island ice on their outward journey, and that on their return across the interior they found that the high central regions retained much of their snow. This suggests that, as might be expected, the ice is only swept clear of snow where and when the predominant gravitational winds * which flow down its flanks have gained impetus.

In addition to its conversion into ice, removal by wind and to a smaller extent by melting, the snow is further assailed by evaporation and its surface is pock-marked. Although I have no figures to prove it, I have little doubt that, as an agent of removal, ablation is second only to the gravitational winds which stream off the dome.

As we found the flanks of the dome snow-free and hard, so the southern party found the saddle deeply buried in wet snow. While the domes have an altitude of more than 2000 feet (the north-westerly dome rising to about 2400 feet and perhaps higher), the saddle may not attain even to 2000 feet, and probably it acts as a collecting ground for snow blown from the higher regions. The region of highland ice on the north side of Wahlenberg Bay performs the same function. All round the coast the island loses much of its supply of fresh snow by the remarkably fierce blizzards which carry it down the steep flanks and out to sea.†

(*b*) *The Highland Ice.*—This merges indistinguishably into the domes in the central regions and stretches from them to the coast. It is the region in which the topographic features of the underlying rock have a marked effect on the movement of the ice and on the configuration of its surface. By far the greater part of the ice of Spitsbergen has passed this condition, to a more recessive stage of the glacial cycle marked by extensive snowfields, long valley glaciers, and an abundance of nunatakkr.‡ North-East Land, however, has not advanced so far beyond the zenith of its glaciation. It represents more truthfully the high latitude in which it lies, a fact which gains weight when we remember that it lies some thousands of feet lower than a large part of the

*K. S. Sandford, *Geogr. Jour.*, vol. 68, 1926, pp. 200–225.

†I suspect that it was one of these sudden and violent blizzards, described in my previous paper, which brought disaster to the *Italia* in 1928 as she approached the north coast of North-East Land. The lower she flew the greater would have been the load of snow and *downward* force of the wind, and to rise would have been to face its full force.

‡See an important comprehensive paper by G. W. Tyrrell, "The Glaciers of Spitsbergen," *Trans. Geol. Soc. Glasgow*, vol. xvii, pt. I, 1919–22, with useful bibliography.

main island of Spitsbergen, and that it is robbed of the first-fruits of the west and south-west winds. When we appreciate these facts we may realize how great is the effect of the Gulf Stream on the islands of the Spitsbergen group, and how marked the contrast between the western regions it influences and the eastern from which it is deflected.

Not a single nunatak projects through the island ice of North-East Land, i.e. there are no isolated high peaks, and the highland ice is similarly free, in marked contrast to conditions on the western side of Hinlopen Strait. There are a few rocky masses projecting through the low ice-terrain near the western

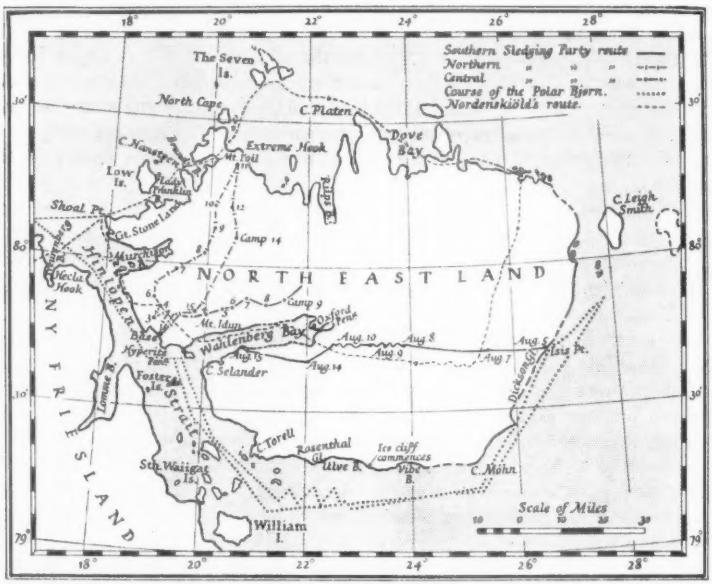


Fig. 1. North-East Land

Nordenskiöld's route is open to correction (see p. 463)

end of the great depression which lies on the east of Wahlenberg Bay. The higher outcrops and outliers are there submerged progressively eastward by the swelling surface of the bordering highland ice, some of them standing out as flat-topped or conical nunatakkr.

On the north coast the rugged topography is reflected in the ice-contour which in the coastal region consists of a number of steep-sided knolls (*e.g.* Mount Toil). Farther inland the lesser of these merge to form rolling country while larger ice-knolls still stand out, but finally a higher and more uniform surface of island ice is established. The same conditions apply in the region at the head of Murchison Bay.* The ice-contour of

*For this and all other information about the ice in the north-western region of the island I am indebted to the members of the northern party, J. R. T. Aldous, W. B. Carslake, and F. A. Montague.

the north coast is markedly steep, considerably steeper than it is on the southern side of the same dome, *i.e.* on the north side of Wahlenberg Bay, the difference depending upon geological structure and topography, as already described.

The relation of surface configuration of the ice to subglacial topography and geology is excellently displayed in a traverse north-west from the Base Camp on the north side of the mouth of Wahlenberg Bay (see Fig. 2). The land first rises by a stiff slope from the shore to about 470 feet, where there is an ice-plateau. This lies on the sub-Carboniferous surface of erosion, exposed elsewhere, and moraines here provide locally-derived fragments of Older Palaeozoic rocks. Then there follows a gentle slope to about 870 feet, where there is a second plateau. The Permo-Carboniferous strata, capped by the dolerite sill, outcrop a few miles away in the outlier of Mount Idun, the surface being about 800–850 feet above sea-level. Finally, by a gradual rise, less marked at about 950 feet, the ice rises gently to about 1200 feet, and there takes on the convex surface of the island ice at an approximate distance of 12 miles from the coast.

On the south side of Wahlenberg Bay the ice " feathers out" near the edge of the great scarp, though short glaciers find their way through breaches in it down to the edge of the bay. From the scarp the ice rises gradually and without break or undulation to form the southern dome, and no marked zone of highland ice can be said to exist here. This depends solely on the simple geological structure.

In the eastern and south-eastern parts of the island the coast is formed by a steep-sided ice-wall 50 to 100 feet high and more than 100 miles long. It stretches from Ulve Bay to Cape Leigh Smith, and is broken only by the small outcrop of Isis Point, which had not been recorded before 1924. This great wall was termed by A. E. Nordenskiöld Dickson's Glacier, and certainly it presents one of the longest terminal ice-walls of the north polar regions. The observations of the southern party in 1924, and of parties landed at Ulve Bay and Cape Mohn, show that the surface is of the greatest uniformity, only slightly broken by crevasses, and devoid of nunatakkr. It rises gradually to the saddle already described. Probably the front is aground on a bed of boulder clay over the whole of its length, as undoubtedly it is where it has been observed, soundings taken near it showing shallow water with a clay bottom. This condition of extreme glaciation savours more of Antarctic than of northern latitudes.

Soon after the saddle is crossed towards the west a wildly confused strip is encountered in prolongation of Wahlenberg Bay (see below), and the saddle itself is comparatively narrow. The collecting ground for this enormous mass of land-ice, which is discharging both to east and west, is thus of small proportions. It is my opinion, therefore, that the supply of snow derived by blizzards from the northern and southern domes adjoining the area is of supreme importance to the nourishing of Dickson's Glacier and to the maintenance of such extreme conditions. To what extent the position of the ice-front has shifted over a period of years I am not prepared to estimate, since earlier, and for that matter recent, mapping of the region is at best approximate and incomplete. From general considerations and observations else-

where I should imagine that the front has retreated.* We have no evidence that the body of ice is making any considerable movement, and the same may be said of its front (see later).

In the greater part of the highland ice, where the ice is not so overwhelming, marked outward movement seems to be concentrated in valley-like depressions and to be governed by the subglacial topography. Consequently the forces at work in these localities are enormous and are made manifest on the surface by mazes of wide crevasses and by other signs which will be described later. In certain localities also the disturbance is increased by the sea flooding the subglacial valleys, so that the congested current of ice is subjected to tidal movement and the wildest confusion results. Such is the confused strip in prolongation of Wahlenberg Bay, referred to above, and called the Eton Glacier. Observation at the head of the bay, *i.e.* at the terminal ice-wall of the glacier, convinced me that the ice was afloat where it entered along the centre line of the fjord, and aground on the north side (the south side was not visited). A variety of direct evidence to confirm this was available, most of which has already been published.† Since the ice-wall was here as much as 100 feet high above water-level, a depth of 800–900 feet is implied, and the shattered and floating Eton Glacier is in strong contrast to Dickson's Glacier, which slides on boulder-clay lubricated by sea-water.

(*c*) The profile of land-ice from Wahlenberg Bay to the north coast can be

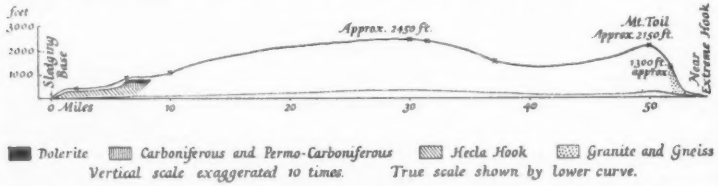


Fig. 2. Profile of land-ice from Sledging Base to north coast near Extreme Hook

constructed by comparing the aneroid barometer records of the northern and central parties with each other, and with the far more accurate readings obtained by mercurial barometer in M.S. *Oiland*.‡ The reading must also be referred to the records of the headquarters camp in Liefde Bay, Northern Spitsbergen, and to other available data. Finally, due allowance must be made for lags in the movements of high and low pressure systems. All these calculations have already been made and verified in connection with the meteorology of the island, to which reference has already been made.

*The positions of Cape Mohn and Isis Point, fixed in 1924, show that the ice-front runs a few miles west of the line shown by A. E. Nordenskiöld, but these were the first and only determinations recorded on the spot, previous positions being estimated from a distance. Comparison is therefore dangerous. The same applies to the remarkable changes made in the map in the region of Cape Leigh Smith in 1925 by Commander Worsley (see 'Under Sail in the Frozen North.' London, 1927), *i.e.* the first accurate survey cannot be compared fairly with previous approximation.

†K. S. Sandford, *Quart. Jour. Geol. Soc., ibid.*, p. 653.

‡This was one of the two sloops chartered by the Expedition. She was in the vicinity for a considerable part of the critical period.

The result is shown in Fig. 2. Owing to the number of sources of small error, absolute accuracy is out of the question. As an approximation, however, the profile shows all that is required of it. On the left side the control exercised by geological structure (*supra*, p. 455) is shown graphically. There is a shortage of data to give the precise height of the dome along the route of the northern party's return from the north coast to the sledging base, and the readings for Camp 14, taken during erratic weather, show a difference of about 150 feet. This has been halved to give the height of 2450 feet above sea-level, the slope from sea-level thus being considerable.

On the right side the subglacial topography makes itself felt once more, and the ice mounts into a separate dome (Mount Toil) before descending steeply and feathering out on rock at about 1300 feet above sea-level. 1300 feet (394 m.) is the height of Extreme Hook, near by, given by De Geer (*op. cit.*). Probably the rock-surface rises under Mount Toil, but of this we have no positive evidence. The ice slope on the seaward side is exceptionally steep, and is best described in Carslake's words: "To get down to the coast from Mount Toil (without sledges) we had to strike nearly due west and so on to the upper part of a glacier running down a well-defined valley. . . . On the return route (direct from the shore at a point about north-east of Mount Toil itself) the ice-dome ended abruptly on rock which was steep enough in places to have involved hands as well as feet, unless I had traversed about to avoid such spots. The ice dome (bare ice) was far too steep to tackle without crampons (which I put on) or step-cutting." This profile is shown as well as possible on the section.

We have no concrete figure for the lowest point of the col between Mount Toil and the main dome, but my section has been examined and corrected by Carslake, who adds the important information that the depression runs fairly directly along the line-head of Murchison Bay to Cape Platen. It is difficult to assign the precise significance of this line in relation to the subglacial geological structure in the present state of our knowledge.

4. *Movement of the Ice*

If there were any doubt that bodily movement of ice is taking place from the interior towards the coasts, assurance would be forthcoming immediately from a number of observations. The most obvious of these would include the calving of icebergs of considerable size (as from the Eton Glacier), the presence of great masses of fresh boulder-clay, the bewildering systems of crevasses in the ice-valleys of the highland ice, and movements actually observed. A little further observation would reveal the humping up of the ice in response to great pressure within the valley-like depressions, and the wall-like sides which some of the main currents of ice present to the bounding ice-country.

We will now consider in greater detail some of these features, but first let it be remembered that such movements are strictly limited to certain definite tracts, and that probably a great part of the glacial covering is stationary. In certain districts the ice has grown where we see it in response to purely meteorological conditions, and it has formed a shield or carapace over elevated areas of land. It may not be augmented beyond this stage, and if at

any time it has been so enlarged, it has fallen back again to those proportions which assure its existence but provide insufficient stimulus to cause its outward movement. It remains indefinitely, and if in course of time change of climate leads to its total disappearance the underlying surface of rock will show little of the former encumbrance. In my opinion such carapaces are marked features of the present glacial phase of North-East Land. They feather out without any sign of movement, and yet the ice is "healthy," *i.e.* solid, green or blue where seen in section, neither rotting nor unduly soiled by dirt or mud. There may be some movement of the mass, as one would be led to suppose from its solidity and maintained structure, but this is balanced by the relation of supply to melting and ablation. With the exception of active ice-movements in the regions which adjoin them, such regions as Mount Idun and much of the southern dome seem to be in this condition and exhibit feathering out of the margin on solid rock. Certainly Mount Idun has been incorporated in more general activities, as the presence of erratic rocks on the exposed subglacial surfaces demonstrates, but this phase has passed. Mount Idun is now an ice-knoll or carapace separated from the main ice-sheet on its north by a transverse depression, and glacial flows branch round either side of it and leave it undisturbed. I believe that such conditions will be found to exist on a much larger scale in the southern dome, and there are many lesser examples.

(*a*) We shall find ice-contour and crevasses to be closely associated, and remembering that land-ice may be in a healthy state of rest, let us turn to those localities where it is in active movement. These are the valley-like depressions, or ice-valleys, in which tensions and compressions to which the ice is being subjected are made manifest on the surface by crevasses and pressure-hummocks. Perhaps we can follow these best by starting from the dome and working towards the coast by each of the several types of valley in turn. First we will take Amen Valley, ascended by the central party from its farthest camp.

As we descend the flank of the dome small crevasses begin to attract our attention, and as we proceed they become a marked feature. We see them running for indefinite distances along the dome, straight as far as the eye can see, not more than about a foot in width and with perfectly regular sides. Moreover they seem to be spaced at regular intervals, and, in fact, perform the rôle of contour lines cut in the ice They appear also to be but a few yards deep. It becomes evident that they are associated with the slope itself, and that they are not, as one might at first suppose, cracks produced by change of volume. The surface layers, non-plastic from want of pressure, are evidently in a state of tension, while at greater depth the ice is tending to flow and is in compression, the stimulus to move and the spacing of the tension-cracks depending on the slope of the surface.

After passing over a zone such as the above, we find ourselves looking down from a shallow saucer-shaped depression into a great amphitheatre many miles wide and contoured by hundreds of crevasses or tension-cracks. Where the slope becomes severe the cracks become crevasses many feet wide with regular and vertical walls and no visible bottom. They retain their regular spacing and parallelism and may be only a few feet apart, until finally there

seems to be more crevasse than ice. Except when well bridged with snow, a condition rarely realized during the summer melt, they make progress with sledges (especially with dogs) almost impossible. Occasionally they are joined by crevasses which cross them at right angles.

I would stress the great length and regularity of these crevasses and the fact that they seem to depend solely on the relation of the breaking-point of the mass to the slope of the surface, *i.e.* there is no evidence of disturbance or interference such as would indicate an obstruction in the path. Further, the crevassing of the sides of the amphitheatre and of the valley beyond seems to show that the ice is flowing into a simple and steep-sided rock-valley not only from its head but also from its sides. There is no indication in the crevasses of overthrusting, and, like contours, they bend up the valley and not down it. Thus there is little, if anything, in common between this type of ice-movement and that of a valley glacier in a mountainous region. Certainly there is movement of the ice, but it savours of slipping down an incline rather than of active forcing forward under its own pressure. I would distinguish therefore the movement of ice in these depressions from valley glaciers. The concave cross-section is maintained as the valley broadens, the rate of flow seems to lessen since the crevasses are not quite so marked, but they retain the characters already described and particularly their spacing in parallel lines at regular intervals.

Such, in a few words, is the ice-amphitheatre. Noting the absence of active movement of true glacier type, one is inclined to associate its characters with a retrogressive state of the ice-sheet, and to form the impression that the highland ice is of no great thickness.

Let us now inspect the region of highland ice adjacent to the amphitheatre and valley depression. The contour-like rôle of the crevasses is maintained, they straighten out from the amphitheatre, decrease somewhat in size, but maintain their regular spacing and parallelism. They seam the intervening high plateau like drains in a marshy field. Thus, in the region of Prospect Col, about 5 miles north of Mount Idun, I noted these cracks regularly spaced on a long slope at 10-yard intervals, and each about a foot and a half in width. A few miles farther on the spacing increased to 27 yards and the cracks were about a foot wide. In this district the ice, broken in this way, rises to about 1200 feet.

I have already expressed the view that the plateaux and gentle slopes contribute to the flow in the valleys, and imply thereby that they are subsidiary ice-sheds to the main flow from the dome itself. But the term "plateau" is of limited application because the change of slope as we near the coast is not drastic, though it exists. Its presence is defined by the edges of the ice-covered outliers of dolerite and younger Palaeozoic rocks, and these are masked by the ice. The shoreward slope is sufficient in some localities, however, to keep the ice in a state of instability, and so crevasses parallel to the concealed edges of the outlier are to be observed. It was in such a situation that a possible example of the movement of the ice was recorded by the central party (see below, p. 464). In many places the highland ice is evidently at rest and virtually without crevasses (as recorded over considerable areas by the northern party).

Now let us turn to other examples of ice-valleys and view them in the light of what has been written above. The ice-valley referred to by the central party as Trouser Valley (the title commemorating an event rather than the valley) serves our next purpose admirably. It is situated between the sledging base and Mount Idun. Its upper end is saucer-shaped, and marked by an ice-fall. So far as we could see, the ice was not markedly broken above the fall, which no doubt is caused by an inequality in the underlying surface of rock. The ice here breaks into blocks separated by wide crevasses. The drop is not more than about 50–75 feet, and is marked only for a few hundred yards. On either side the regular slope of the valley, still covered with deep snow, contrasted sharply with the bare and broken ice. Only close inspection will convince an observer that these falls, which are fairly common features, are not outcrops of rock, hence, no doubt, many of the errors in existing maps.*

The valley is 150 feet deep and about 3 miles wide at the point of our crossing near the ice-fall. On passing towards the east side we crossed fifteen wide crevasses, spaced at regular intervals, within 440 yards. They were parallel to one another and to the valley side, were deep and ran for a considerable distance before they were bridged by snow which hid the continuation of the series. Trouser Valley is a good example of the lateral as well as the head supply of the ice, with essentially concave cross-section and lacking all the characteristics of a valley glacier.

Passing now to the east side of Prospect Col we find another important feature in a wide ice-valley which sweeps down and skirts the east side of the Mount Idun outlier. It has the type of crevasse and cross-section already described and rises gently to the ice-plateau beyond. On the Prospect Col side, however, we found a remarkable *transverse* shear-crack which marked off the side of the valley from the higher ice slopes. It was 20 feet or more wide, possessed the usual parallel and vertical sides, and ran straight inland for half a mile or more and was then bridged by snow and obscured. Where open it was also choked with fallen masses of snow. The great cleft seems to mark the line of tension on the concave side of a somewhat sinuous ice-valley, but, so far as our experience of North-East Land went, it was abnormal.

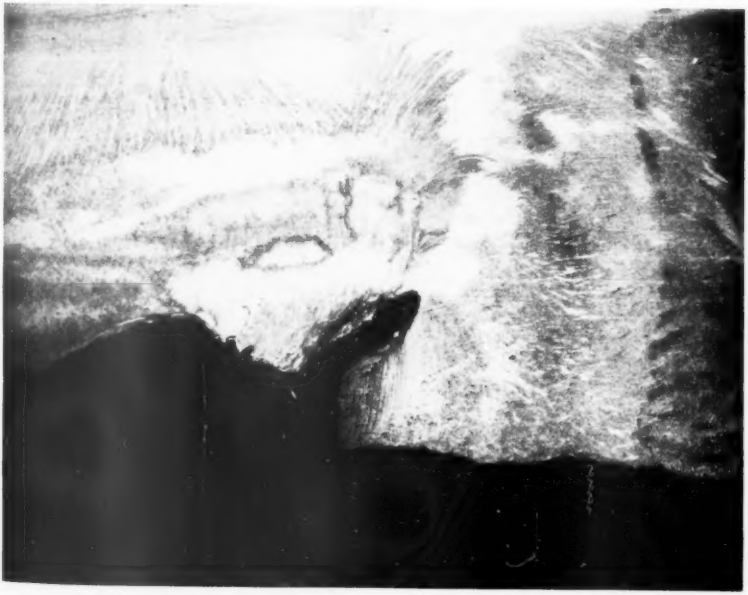
A similarly situated crevasse of about the same size crossed the path of the northern party, and has been described to me by Carslake. It was plugged with a V-shaped mass of snow, which had fallen away from the sides to leave a crack about 2 feet wide at the surface and wider lower down, but strong enough to bear the weight of men and sledges.

There now remain the two extreme types of ice-valley. In the first, movement is at a minimum and crevasses are insignificant. The ice is probably thick and occupying a gently sloping and broad rock-valley, and the surface is but slightly distinguished from the general rolling topography of the highland ice. The second marks the extreme of activity, and illustrates the humping up of the surface and development of wall-like ridges. It was recorded on many occasions by the northern and central parties. The most impressive and most formidable example encountered by the central party lay between

*The most recent geological map available in 1924 (Ordnance Survey of Great Britain, Map No. G.S.G.S. 2878, 1918) showed rock outcrop over a large area which was in reality covered by highland ice without nunatakkr.

Phot. F. Tymms

Air photograph of Highland Ice feathering out on land (left, no ice-cliff), bordering sea in centre (ice-cliff), and rising steeply inland, ice being in carapace stage. Hyperite Peninsula, near sledging base



Phot. F. Tymms

Edge of above carapace, forking round rock outcrop, with active glacier on right and fan of crevasses between carapace and glacier (centre background)

Phot. R. A. Frazer

Parallel crevasses on flanks of ice-valley (Trouser valley)

Phot. R. A. Frazer

Part of ice-amphitheatre ribbed with crevasses, near Camp 10 of Central Party: Wahlenberg Bay beyond

Camps 7 and 10, Camp 11 being pitched upon it on the return journey, close to the site of Camp 7. Its contour was smooth and like a whale's back, its longer axis being up and down the valley. The flanks were smooth in outline and rather steep, presenting an " icewall " or steep ice slope to both sides of the valley-like depression of which it occupied a part. About 2 miles in width, the mass rose 300 to 400 feet from the snow-covered valley floor on either side of it as a harsh barrier of naked ice gashed by great crevasses. These also were of a type new to our experience in North-East Land. The remarkable parallelism which we had noted elswehere was maintained to a certain extent, but transverse crevasses joined together the main system to produce a maze of pitfalls. Crevasses expanded from a width of a few feet to as many yards within a few paces; they approached and joined each other at small angles, leaving narrow wedges of ice between them, or turned sharply and continued in the new direction.

The paths which R. A. Frazer found on the outward and return journeys threaded their way upward and through this extraordinary maze. Trial routes came to an end on a wedge or at a junction of crevasses too big to negotiate, and the way lay along blocks 10–15 feet wide between crevasses nearly twice their width. On the outward journey snow bridges were available and strong, but on our return they had collapsed or were on the point of doing so, while the ice itself was bare and slippery. Dogs were at a great disadvantage in such surroundings. No bottom or visible narrowing was seen on looking down into the crevasses. On our return the fallen snow bridges lay in them in tumbled confusion of frosty white, blue, and green, festooned with icicles a few feet long, in inspiring contrast to the deeper blue of the solid ice and black obscurity beneath. One could but admire the beauty of this otherwise forbidding place.

An unusual feature seen near Camp 11, and perhaps indicative of the extreme pressure to which the ice is subjected in this hummock, was a large cone of ice-slabs. It was situated in the midst of an intensely crevassed mass of ice and stood above the general level to a height of about 20 feet. Unfortunately it could not be reached for close inspection. Probably it owed its origin to wedges and blocks of ice being forced together and finding relief by rearing upward.

Viewed from a distance, the main crevasses were seen to run in more or less parallel bands from side to side over the whale's back and to simulate the convex system of a valley glacier. From the top of the ridge we saw that this structure was repeated in a similar hummock behind the Eton Glacier, *i.e.* beyond the head of Wahlenberg Bay, upon which we looked down from this vantage point. We could see also that round the back of that largest of all the amphitheatres the contour-crevassing was continued on a grand scale. On the south side of the Eton Glacier also the southern party found a glacier-wall opposed to the neighbouring ice-country, and they had considerable difficulty in descending it. As already stated, the centre line of the Eton Glacier is probably afloat, hence the state of utter chaos. This, no doubt, stimulates movement towards the line of escape from the flanks of the amphitheatre, and the region, like that which we have just described, is one of glacial activity.

(*b*) " Ice-canals" are the most debated of all the glacial features of North-

East Land, and their investigation was one of the objectives of the sledging parties in 1924. I am bound, therefore, to make a digression at this point to discuss them. Fortunately much has been done in this matter already, and the reader is referred to Binney's appendix to his own paper* and to some remarks by R. A. Frazer and myself in a further appendix to that paper.† Binney has included a summary of A. E. Nordenskiöld's original description, published in his 'Arctic Voyages,' a book which was out of print nearly fifty years ago.

Having read the original account after writing the earlier sections of this paper, I am the more surprised to find how closely my account of the crevasses of the amphitheatres agrees with what Nordenskiöld found on a far grander scale, and I am convinced that, except in certain detail, the features are the same. He says the "canals" were parallel to each other, as much as 100 feet wide, with lesser crevasses, deep and snow covered, bounding them. Dangerous cross-fissures intersected them. "Sometimes, also, there occurred other depressions, bounded in all directions by precipitous sides, of greater depth than the glacier *canals*, but of limited extent. . . ." (p. 259); these were called "glacier docks." A little before this (p. 257), speaking of the crevasses in general, he says: "The fissures in general run parallel with each other, in straight lines, but they are also sometimes bent." All this applies to the crevasses of the amphitheatres and deep chasms comparable with the "glacier docks" were common enough in the whale's back hummocks at points of intersection of major cross-crevasses with the main series.

Nordenskiöld found snow bridges across his "canals" at intervals and crossing them "in capricious zigzag." Binney's party encountered crevasses of equal width, but bridges were lacking: this may be due to the time of year, since Nordenskiöld was in North-East Land in June 1873, before any sign of melting had appeared, whereas Binney was there in August.

We now come to the all-important point of dissimilarity: Nordenskiöld states that the "canals" were up to 40 feet deep, and that he "often used the bottom of a *canal* as a place to pitch our tent" (p. 259). No such feature was observed in 1924. He does not say whether this floor was of ice or a subsided snow bridge, but in attempting to account for the "canals," he suggests that a wedge of ice became separated by contraction in the mass, and that thereafter it was lowered between parallel cracks, which widened into crevasses at the sides of the "canal," having the wedge between them as its floor. If this is the true condition, *i.e.* a glacier-ice floor, we may say at once that no such feature was seen in 1924, and that the "canals" are either new to science or, as I would suggest, partially recemented crevasses or ice-dykes such as Wright and Priestley have figured and described from Antarctica.‡ The abundance of large crevasses and the heavy summer melting in North-East Land, unknown to Nordenskiöld, favour this hypothesis. If a snow bridge is implied, that described by Carslake (p. 460) meets the case, except that it had not sunk deep and that no one would have chosen to camp on it if it had. Moreover, Nordenskiöld was a traveller of great experience, and we cannot accuse him of camping on so dangerous a platform, especially as he states that sites for

Op. cit., pp. 38–40. †*Op. cit.*, pp. 116–120.
‡*Op. cit.* Pl. CLVIII and p. 239.

camps were carefully "sounded" owing to the dangerous and deceptive snow bridges which frequently gave way beneath him.*

Binney, in his appendix, has shown conclusively that Nordenskiöld's route is inaccurately marked in the map in 'Arctic Voyages,' and the geological evidence on which this correction is in some measure based is given in my paper on "The Geology of North-East Land."† Without re-stating the evidence we may conclude that Nordenskiöld, approaching from the north, did not cross the belt of shattered ice which lies in eastward prolongation of Wahlenberg Bay, but that he turned westward on seeing it before him, just as Binney's party was forced back to its south side after getting entangled in it in a fog. That being so, though both parties have undoubtedly been in the same area, their routes are separated by the narrow and impassable shattered belt.

Setting aside the question of the floor of the "canals" for the moment, I feel confident that the gigantic crevasses which Nordenskiöld and Binney saw were essentially similar features, and that they are to be identified with the crevasses of the amphitheatres already described, the difference being one of proportions only. These are tension cracks formed in the upper layers of the highland ice as it creeps over slopes without taking upon itself the features of a valley glacier. Their size is controlled, I believe, primarily by the thickness of the ice and its rate of movement.

Now the region lying to the east of Wahlenberg Bay is *par excellence* a huge amphitheatre with steep rock sides, and there is every reason to suppose that the ice which lies in it is of great thickness. Moreover, the shattered belt of ice which occupies its centre-line is due to the eastward prolongation of the deep Wahlenberg Bay and to the introduction of tidal effects. A threefold acceleration is thus imparted to ice approaching the centre-line from the sides of the amphitheatre by: (1) rapid removal westward into the bay, by floating; (2) sudden increase in available space when the incoming and converging ice reaches the deep central channel; (3) melting of the ice therein from below, by sea water. Excessive tension and crevasses of exceptional size may well be expected in such circumstances.

In my opinion this decreases appreciably our difficulty with regard to the "canals," and I look upon them essentially as huge crevasses such as Binney saw. Whether Nordenskiöld was camping on snow or ice within them we can never determine; if it was ice, as seems probable, I suggest that it was of secondary formation and of the type seen in the recemented crevasses or ice-dykes of Antarctica.

That crevasses of such size take some years to form seems certain, but their sharp edges and apparent freshness seem to militate against any suggestion that the "canals" were due to long-continued ablation of the surfaces of minor crevasses. Nordenskiöld was emphatic in his denial that they could be the courses of glacial rivers, and his suggestions that they were due to faulting or the subsidence of exceedingly long and narrow wedges of ice do not carry conviction.

*Such bridging of crevasses by blizzards, without filling them, was frequently observed in 1924, and was the cause of some inconvenience.

†*Loc. cit.*

(*c*) Rafting-up of glacial material was evident, and a good example was seen near the sledging base. Here, at a distance of a few miles from the coast and at a height of about 500 feet, with no nunatak to supply the material, dirt-cones and surface-moraines of considerable size were found. Those visited consisted of angular and subangular fragments of Lower Palaeozoic rocks, a few of them striated, with rare waterworn pebbles of the same materials, and some grey mud. The moraines rested on blue ice from which they had melted out, and when visited in the middle of August they were in process of sinking into it again by their own weight, and by the effect of radiation from their surface. Maybe they repeat this process annually. Since there was no outcrop which could have provided the material, I was forced to the conclusion that it had been elevated from the subglacial surface by thrust planes in the ice, which is probably of no great thickness at this point. Near by, alongside our base, a strong flow of ice reaches the sea.

The more widely spread evidence of such thrusting movements is to be seen in the regions of great pressure-hummocks in the ice-valleys. Patches of ice are impregnated with mud and with fine grains which, from examination under the microscope, I assign to the Lower Palaeozoic rocks. The material is readily melted out and so may be disseminated by streams or wind. But streams do not run far in this broken country before they plunge into a crevasse. Moreover, the mud is scattered on the surface of the ice-plateaux, but I did not observe it on a single occasion in freshly blown snow, nor in the snow or ice of the dome.

No doubt it is carried by winds, but the strongest winds and blizzards are outward-flowing and disseminate it only down the slopes. Finally the mud increased appreciably in quantity as we went eastward, where Lower Palaeozoic rocks form high ground on the north of Wahlenberg Bay and the younger rocks occur only on its south side (so far as known). The marked concentration of the material in the most broken country and its local concentration even in these localities leaves little doubt in my mind that its origin is entirely subglacial, and that it is brought to the surface by thrusting in the pressure hummocks. Subsequently it is disseminated to some extent by wind and water, but the latter serves rather to re-concentrate it in the depth of the ice by carrying it back into crevasses. In a similar situation, but in the zone of Permo-Carboniferous rocks, the ice was seen on one or two occasions to be discoloured by buff or yellow particles too minute to be distinguished. These are the dominant colours of the local rocks, where exposed.

It may be suggested that the mud, evidently of subglacial origin, is brought to the surface by subglacial or englacial streams. Of this, however, there is no evidence, and the regions of crevasses are notably dry.

(*d*) The observed movement of the ice in the interior is perhaps the least satisfactory of all evidence, and we may quote it briefly for what it is worth. While the Central party was camped about 5 miles north of Mount Idun it was troubled by disquieting noises which seemed to come from beneath the tent. After a while, on going outside we found one of the dogs dangling from his harness in a crevasse which had been too narrow to concern us on camping. The snow bridge had collapsed and the supply of water which we had got by rope and bucket at about 20 feet had failed and was not renewed. The tem-

Phot. F. Tymms

Air photograph of glacier descending steeply to sea-level west of Mount Idun (in background). Rock-cliff in foreground

Phot. F. Tymms

Air photograph of part of Mount Idun, showing series of lakes on and bordering the ice: stream falling over 850-foot cliff with snow slopes

Stream entrenched in surface of ice *Phot. R. A. Frazer*

Stream running out of ice-pipe *Phot. K. S. S.*

"Snow-stopes" due to melting of deep snow from below *Phot. K. S. S.*

perature had not varied appreciably during the time, and had remained at about zero Centigrade.

In other places the rumbles and thuds of collapsing snow bridges during periods of melting were punctuated by sharp rending noises like rifle-fire in the deeper roar of distant guns. Deflections of water deep in crevasses became numerous and were accompanied by change of tone in the general noise. These may or may not have been associated with movements of the ice itself. At another place a crack about an inch wide opened in the course of a few hours along a line on which the tent was pitched.

5. *Removal of Material from the Surface*

The surface of the snow and ice may be reduced in a variety of ways which we may classify as follows: (1) without melting: evaporation (ablation), and wind (blizzards); (2) by melting: thaw, and further destruction by thaw water. We will take these in order.

(*a*) Ablation is a continual source of loss to the surface and is most marked on the dome, where thaw is at a minimum, but it is evident also in the highland ice. It is dealt with more fully in other sections of this paper, and need not detain us here.

(*b*) Blizzards are particularly potent agents of destruction in the higher parts of the ice-sheet. They have been dealt with in some detail in another paper.* On the lower slopes they lead to the choking of crevasses with vast quantities of driven snow, and leave on the surface long "sastrugi," or sinuous banks of snow, which subsequently mark the direction of the wind. Any obstacle forms the centre of a drift from which attenuated snow-banks stretch down-wind like the horns of a crescent. The obstacle itself is almost, if not entirely, submerged, and tents have to be freed at intervals by digging. Valleys and hollows are sometimes filled to great depths (see below, p. 467). Blizzards are as much agents of deposition in sheltered places as they are of abrasion of exposed surfaces.

(*c*) Thaw when once it gets full sway, exerts an overwhelming influence upon the condition of the surface.† Many of its effects have been described in the paper to which reference has already been made, and further detail will be found in the next section of the present paper. Here we need refer only to its more widespread results.

In the first place, unconsolidated snow is converted into a mass of slush. The melt-water saturates the lower layers, and if the slope of the underlying surface of ice is insufficient to carry off the drainage an almost impassable snow-morass results. It was such obstacles as these that hindered the sledging parties in 1924. Progress was attended by frequent immersion, the sledges foundered, and the dogs' feet suffered excessively. Attempts to use ski ended in disaster, as sooner or later they sank deep or ran under a thin sheet of ice. To make camp was almost as unpleasant as trying to advance. An advance of a few miles in twenty-four hours was good: ‡ it was accompanied

*K. S. Sandford, *Geogr. Jour.*, vol. 68, 1926, pp. 200–225.

†The overwhelming effects of thaw described in this section are in striking, and as yet unexplained, contrast to the absence of thaw, and of evidence thereof, noted by A. E. Nordenskiöld in June 1873 ('Arctic Voyages,' 1879, p. 256).

‡See the diary-narrative of the sledging parties in 'With Seaplane and Sledge in the Arctic.'

by the temporary exhaustion of men and dogs. Snow-morass is perhaps the most obdurate of all obstacles in North-East Land. Long-continued freezing converts the whole mass into solid ice and adds it to the body of the ice-sheet: lesser degrees of frost produce varying thicknesses of crust which may or may not bear the weight of men and sledges. The existence of slush under thick crust even after prolonged freezing is a noteworthy feature.

If the slope of the general surface is sufficient, the melt-water collects into countless streams. Their direction is consequent upon the general slope or upon the subglacial topography where it makes itself felt in the highland ice. On the dome water was limited to a brisk flow along the contour-like cracks on its lower flanks, one overflowing into the next below it. A large part of this water is engulfed in the crevasses of the amphitheatres and highland slopes and becomes englacial or subglacial.

The streams may drain into a snow morass, and at intervals rivers of considerable breadth may issue from its lower margin. The streams and rivers are usually fairly shallow, but where they flow across ice-plateaux of slight gradient there is a marked tendency for snow either to remain or to collect along their sides, and some interesting features result. The simple condition is a stream with banks of firm snow a few feet higher than its own level. Hemmed in between these walls it may cut downward into solid ice instead of spreading out into a sheet of water. Where the general slope is considerable the ice is deeply furrowed by streams and rivers, and the steep-sided torrent-beds may be impassable for sledges. Bearing in mind that these streams carry no load of rock, it will be realized that the cutting of deep torrent-beds is a remarkable feat, effected by water alone at a temperature little if at all above freezing-point. Along these deeply entrenched ravines the snow banks disappear.

Low temperatures rapidly convert the snow banks into a mass of ice, and they are then "permanent," and may be enlarged until the stream is flowing appreciably above the level of the surrounding surface. Such embanked channels are almost as difficult to cross as the ravines, and sledging parties in this zone of slush or morass, embanked or entrenched rivers, and lakes, are offered a poor selection of almost impossible routes. The highland ice of North-East Land offers but small choice between this zone of slush and the crevasse-fields which intersect it.

A further stage is reached when the embanked or entrenched watercourse is covered by snow, either by normal fall or by blizzard. The results, as we observed them, were striking. In certain instances a layer of snow over the stream was saturated and converted into ice. This was one or two feet thick, and it remained covered by the rest of the fall. The river had thus imprisoned itself in a pipe like a water-main, running along the surface of the ice and covered by unconsolidated snow, the removal of which by wind or melting laid bare some of these remarkable structures for our inspection. But the process did not stop at this point, for some of the "water-mains" ran down fairly steep slopes. When melting became a serious factor the pipes were overcharged and the water they contained was under considerable pressure. Accordingly some of them burst, throwing blocks of clean snow-ice into confused piles like small volcanoes at intervals along their courses. Such a chain

of "volcanoes," joined together by their pipe and running down a long slope, was one of the strangest features observed by the central party. The pipes were as much as 6 feet in height, and the "volcanoes" about 15 feet. A particularly large specimen was about 30 feet high, and its base about 40 feet in diameter. They were observed near Camp 10.*

Astonishing results attended the drainage of water into ice-hollows filled with snow, such as Amen Valley, where the following observations were made. The valley had previously been filled with snow which lay unconsolidated to a depth of at least 60 feet in the centre, tapering out on the slopes. The thaw-water ran down the ice slopes and disappeared under the surface of snow, and an enormous volume was collected of which some found its way down the valley.

The central party was brought to a halt in front of the valley and never crossed it, further progress being found possible only by a lengthy detour round its head. In the days that followed our arrival we saw enormous holes develop in the snow, and reconnaissance showed that it was being removed from below, like upward stoping in a mine. Beyond doubt this was effected by the solvent action of the water which had collected beneath it on the ice-floor. At the end of a week the surface of the snow-filling, which had been in a treacherous condition when we first encountered it, was riddled with cavernous holes, the surface sagged ominously in all directions, and a ski stick thrust through such spots revealed other oubliette-like caverns. As melting continued the snow fell in from the sides of these extraordinary stopes and roofs collapsed to reveal new ones, with continual rumble and roar, and the entire aspect of the valley changed. Some of the holes were 200 feet long by 30 broad, and 60 feet or more deep. As an obstacle this type of melting was supreme, since the snow was soft and presented special difficulties in the event of a fall.

Surface water is engulfed *in toto* in the vicinity of open crevasses, which imitate in this respect the "grykes" of a limestone plateau. The endless variety of swallow holes, gashes, and pot-holes is reproduced with considerable accuracy, and, for that matter, the processes are rather similar. To be camped near such a spot was to hear the ever-changing roar of water falling in splendid waterfalls into the depths of crevasses, to watch it swirling in pot-holes till it cut them away, filling shallow crevasses and cascading into deeper ones until it cut the lip away and flowed more smoothly. From beneath apparently solid ice came the continual throb of water coursing through channels not open to the surface. For days at a time (as at Amen Camp) the gasping, roaring, and hissing of the water as it coursed through the crevasse-system was kept up, never the same for more than a few minutes. This, combined with the noise like a distant bombardment from the collapsing snow in the ice-valley before us, gave us an impressive idea of the part played by running water in North-East Land.

Lakes of many types occur upon the surface of the highland ice or depend upon its existence. All arise from the spring and summer melt and are frozen and thawed at intervals throughout the season. The snow morass is, in effect, a lake. More obvious are the delightful tarns of brilliant colour, from deepest

*Similar pipes were observed in New Friesland by Sir Martin Conway; see 'The First Crossing of Spitsbergen' (London, 1897), p. 285.

blue to brilliant green, which relieve the monotony of the undulating ice. They collect their water from the neighbouring slopes, fill hollows, and brim over in the simplest manner which needs no further description. A variation of these was seen near Prospect Col, where the lake itself had been drained, probably by a crevasse, but cold winds had ruffled its surface and films of water had frozen as the lake slowly fell. A fantastic array of festooned and encrusted hummocks of ice occupied its site and marked its boundaries.

Crevasses run under most of the lakes and render them liable to drain at any moment, and yet this rarely seems to happen. In two instances at least we saw lakes perched 200 feet and more above the floors of the ice-valleys (Trouser and Amen Valleys), in regions seamed with great crevasses. Their size did not vary (though we only saw the former for a short time), nor did they drain away, nor had they visible outlet; probably they were regulated by the crevasses themselves. Some of the lakes certainly change considerably in volume as a result of excessive melting, and a valley which we crossed dry-shod on our outward journey, skirting a small tarn, was occupied by an extensive lake on our return.

The effect of water running or collecting under deep snow has already been described: on our return journey we encountered a rather similar example, but the ice slopes were fairly gentle and the drainage was ponded against an ice ridge. The run-off was particularly heavy. A considerable thickness of snow remained over the deepest part of the depression, and it was in the condition already described. It seemed to be virtually afloat on a lake, but was crossed without mishap.

Lakes at the edge of the ice are fairly numerous. These are best shown in the beautiful series illustrated. Here a lake lies in an ice-hollow and drains by a deep gully into another, ponded between the ice and the solid rock, the water finally escaping by falling over a cliff.

6. *Minor Structures of Snow and Ice*

It is not intended in this paper to enter upon the physical properties and crystallography of snow and ice, but mention will be made of more general conditions and of peculiar structures.

At the time of our visit, in the midst of the spring and summer melt, snow remained chiefly in the hollows and ice-valleys of the highland ice. In general, however, the highland ice was covered only by a few feet of slush and rapidly thawing snow which made progress slow and difficult. Occasionally blizzards blew fresh supplies from the dome.

The condition of the snow seemed to depend chiefly on temperature and the quantity of water present, *i.e.* it varied according to the prevailing temperature, from pure slush, through a downy amorphous substance, to a highly crystalline solid. At the height of the melt 10 inches of snow were removed by evaporation and melting in sixty-six hours (measured by the central party at their farthest camp). On the other hand, a period of frost and blizzard cemented the whole of the wet mass to the solid ice upon which it rested (as described above). During such brief periods, in situations less affected by melting, a section from surface to solid ice was as follows: (1) surface film of ice-glaze, from sun-melting in hottest hours of the day; (2) a few inches of columnar

crystals of ice, formed by the recrystallization of and growth of a system of joints in (3); (3) "shrapnel-ice," as we termed it, an assemblage of lumps of ice with allotriomorphic crystalline structure, like compacted hailstones, from about the size of maize to that of shrapnel bullets. These were sometimes loose like fine gravel and sometimes compacted into a solid mass. They had probably been formed by alternate saturation of snow by thaw-water and freezing, perhaps over a period of years. The mass was separated from the underlying blue ice by a marked "unconformity." Solution or evaporation sometimes reduced this layer to a surface of fine spikes and needles.

Since much of the snow in North-East Land appears to be blown away or melted, the only manner in which it seems to be added directly to the surface of the blue ice is by the final cementation by freezing of such masses as the above. Apart from this, however, blizzards pour enormous quantities of snow into the crevasses, where they are engulfed. Rain passes through the snow to a depth of a few inches, where it may freeze. There result from this: (1) A layer of ice in the snow, which must be distinguished from a surface crust and in a section must not be given value as an annual band; (2) lumps or balls of ice, like concretions in the snow.

A common feature of bare ice-surfaces is the filling of cracks with long crystals of ice growing from the sides, as in a mineral vein. They are curved in the direction of flow of any current of water passing along the crack. Partial solution and draining of the water produces an intricate interdigitation of the crystals, while freezing of the contents of the crack leads to a coarse holocrystalline structure. Joint-like cracks, often only a few millimetres wide and enclosing rectangular areas or in long sweeping lines, were marked in cold weather by the efflorescence of ice-crystals to a height of about half an inch.

The presence of large quantities of air in the solid blue or green ice and its liberation on melting (especially of icebergs in the adjacent waters), with murmuring and tinkling sounds, is an observation as old, I suspect, as Polar exploration.

Impurities in the snow and ice were common in the highland ice, but were not observed on the dome. They consist of dust blown from moraines or rock surfaces, or more commonly in North-East Land, of fine mud from dirty ice brought up to the surface in the confused ice-valleys. During periods of cold and sunny weather when melting was not taking place, radiation pits were formed round such dark impurities and they sank, became concentrated, and their action was then the more marked. "Cryoconite holes"* of considerable size were thus formed. At the end of the period of sledging I found some near our base into which I could thrust my arm to the elbow. These were not observed when we left a month earlier. In the interval the slight amount of dark dust and mud which lay at the bottom of them had caused the formation of cylindrical holes in solid ice commonly to a depth of 10 inches, with a diameter of 3 inches. Some had encroached upon one another and formed a honeycomb. Moreover I noted them at the bottom of a stream which had cut its bed 4 feet below the general surface of the ice, the inference being that they were formed rapidly during the cold and sunny period after the main melting was over and the stream-beds had become dry. Alongside lay a dump of stores

*See C. S. Wright and R. E. Priestley, *op. cit.*, p. 283.

left by the northern party after their first day's journey: no cryoconite holes occurred below this covering, but the stores had sunk about an inch farther into the solid ice than the general surface had been lowered by evaporation and melting. So far as my observations went, I did not notice any inclination of the holes towards the north (*i.e.* away from the sun at its highest diurnal point), and do not think that this would be likely to occur in so high a latitude. Nordenskiöld comments on the absence of these holes in June 1873.*

I have no evidence of the "cosmic dust"† spoken of by earlier writers, and the snow and ice of the dome were notably clean. "Red snow" (an alga) was found by the central party at its farthest camp, this being its only record from the interior of North-East Land.

(*To be continued*)

THE PARK-LANDER MEMORIAL

ALL geographers will have been glad to see the letter of the Earl of Scarbrough published in *The Times* of September 30 announcing the completion of the Obelisk in memory of Mungo Park and Richard Lander which has been erected on the Island of Jebba not far from the bridge which carries the railway from Lagos to Kano across the Niger at this point.

The project for this memorial was put forward so long ago as 1911, when an appeal for funds was made by Lord Curzon, President of the Royal Geographical Society, Sir George Goldie, President of the African Society, and Lord Scarbrough, Chairman of the Niger Company. It was originally proposed to erect an obelisk on the shore at Forcados. Then it was suggested that the memorial might be used as a lighthouse to mark the approach to the port, and a scheme was prepared providing a tower with a chamber in which the Nigerian Government might place a lighthouse lantern when it appeared to them that the necessities of navigation required it. At the outbreak of war the scheme was at this stage, when some hundreds of pounds had been collected but perhaps not enough to complete the rather ambitious tower. When after the war the project was revived, it was suggested by Sir Hugh Clifford, then Governor of Nigeria, that Forcados was no longer a suitable place for the memorial, since the development of Lagos had diverted traffic from Forcados, which was now comparatively little visited by Europeans. He suggested as an alternative the Island of Jebba where the railway crossed the Niger. The island is only some 80 miles below Bussa, where Mungo Park's traverse down the river was terminated by his death by drowning in the course of a combat with natives who tried to obstruct his passage, and it was precisely at Bussa that Richard Lander first saw the Niger, and from Bussa he completed the traverse to the sea. It was, then, more appropriate to place the memorial near the spot where Mungo Park's work ended and Richard Lander's began. In the course of correspondence with the Governor of Nigeria the scheme which has now been carried out gradually took the shape that the monument should be erected by the Public Works Department from

*A. E. Nordenskiöld, *op. cit.*, p. 258.
†*Ibid.*, pp. 187.

The Park-Lander Memorial on Jebba Island, River Niger

Mungo Park

Born near Selkirk 10 September 1771
Graduated in Medicine at Edinburgh 1791
First journey Gambia to Niger at Sego 1795–1799
Second journey Gambia to Niger at Bussa by 1805

Richard Lander

Born at Truro 8 February 1804
Travelled with Clapperton 1825–1827
Descended the Niger from Bussa to the sea 1830
Died of wounds at Fernando Po 1834

stone quarried locally, and that it should bear an inscription on a cast bronze plate sent from England. The contractors, Messrs. Thomas and Edge, who had prepared the plans for a monument in cut stone to be sent from England, very generously supported the more economical project of local construction and asked that the plans they had prepared should be accepted as their contribution to the enterprise. The work of the building has been carried out by the Public Works Department, and arrangements have been made to lay out the site and to maintain it in good order. The Committee now find themselves with a substantial balance in hand, which they propose to ask the Council of this Society to hold in trust as a fund for the maintenance of the monument in good repair.

The accompanying photograph, which is one of a series presented to the Society by the Committee, shows the memorial as erected, and in the distance the celebrated Juju Rock. It does not seem that there is as yet any survey of the neighbourhood upon an adequate scale, and we are, therefore, unable to indicate the precise position of the monument, but by putting together various evidence it appears that it must stand on the middle or main Island of Jebba a little upstream of the railway bridge and downstream from the Juju Rock, which stands isolated in the river above Jebba. Close to this rock the steamer *Dayspring* was wrecked in 1857, and recent photographs show portions of her boiler and hull surviving on the shore. We are informed that a piece of the machinery which had been removed into the forest is now erected on the platform of Jebbe Station.

When in the near future the monument is formally unveiled and inaugurated by the Governor of Nigeria the first steps will have been completed in carrying out a long-neglected task. West Africa had done little to commemorate the name and fame of her pioneers. Mungo Park and Richard Lander, who are commemorated jointly in this memorial and whose portraits from the Society's collection we publish in the accompanying plate, are among the greatest names, and they are happily commemorated in one memorial because between them they exactly completed the first traverse of the river from near its source to the sea. But there are other names worthy of commemoration, and we may hope that the sight of the Park-Lander obelisk, so conspicuous to all travellers by the Nigerian Railway, will stimulate activity in commemorating those others who have as yet no memorial.

SOME EQUAL-AREA PROJECTIONS OF THE SPHERE

LIEUT.-COL. J. E. E. CRASTER, O.B.E.

THE simplest equal-area projection of the whole sphere is the Sinusoidal, or Sanson. In Fig. 1 the sector EQPC represents the north-western quarter of a Sanson projection. EC is the equator, PC is the central meridian, and the curve PQE is the meridian 180° west—a sine curve. If R is the radius of the sphere, then EC$=\pi$R, and PC$=\frac{1}{2}\pi$R. It is convenient to take PC as unity. Then R has the value 0·63662.

It is possible to imitate the Sanson projection very closely by substituting

for the sine curve a hyperbola. Let us suppose that the required hyperbola is represented by the curve EQP in Fig. 1. Then the hyperbola that will imitate the Sanson 180° meridian most closely must satisfy the following conditions:

It must pass through the points E and P. The area of the sector EQPC of the hyperbola must be equal to the area of the same sector of the Sanson projection; that is πR^2, where R has the value 0·63662.

In the usual notation, with origin at O, the equation of the hyperbola will

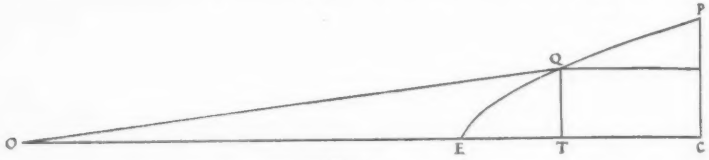


Fig. 1

be $x^2/a^2-y^2/b^2=1$. The area of any sector ETQ is $\frac{1}{2}xy-\frac{1}{2}ab \log_e (x/a+y/b)$. Hence the area of the sector EQPC is $\frac{1}{2}(a+2)-\frac{1}{2}ab \log_e (1+2/a+1/b)$, and this area must be made equal to πR^2, where R has the value 0·63662.

It has been found, by trial, that the values $a=3{\cdot}5875$ and $b=0{\cdot}8375$ satisfy the conditions. If these values are substituted, and the curve is plotted, it will be found to correspond very closely with the Sanson 180° meridian.

To find the positions for the parallels of latitude on the hyperbolic projection, we must equate the area of a strip on the projection to the area of the corresponding zone on the sphere. If y is the distance from the equator of any parallel of latitude ϕ, then

$$\tfrac{1}{2}xy-\tfrac{1}{2}ab \log_e (x/a+y/b)+(a+2-x)y=\pi R^2 \sin\phi$$

The positions of the parallels for the hyperbolic projection which is nearest to the Sanson have been calculated, and are shown in the table at the end of this paper.

Since the Sanson projection is the more easily constructed, it should be preferred to the hyperbolic projection, but the latter is of interest because it is the first of a series of equal-area projections, some of which are useful, and perhaps preferable to the Sanson.

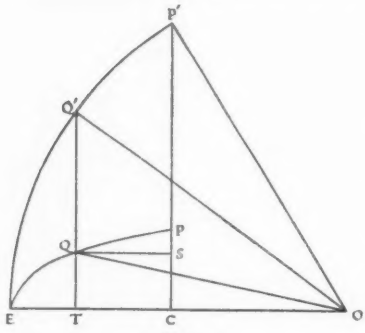


Fig. 2

If we decrease the eccentricity of the hyperbola, but maintain the values EC=2 and PC=1, we shall obtain another hyperbolic projection which departs appreciably from the Sanson. When the eccentricity is unity, the curve EQP becomes a parabola, and the construction of the projection is much simplified. The equation of the parabola is $y^2=\frac{1}{4}x$, and the value of R is 0·65147. The position of any parallel of latitude ϕ is given by the equation $\pi R^2 \sin\phi=2y-\frac{1}{3}y^3$.

The value of y for every 10° of latitude from 0° to 90° for the parabolic projection is given in the table at the end of this paper.

If we decrease the eccentricity of the 180° meridian still further, the curve becomes an ellipse. Fig. 2 shows part of the ellipse and its auxiliary circle. The coordinates of any point Q on the meridian curve are $x=a\cos\theta$, $y=b\sin\theta$, where θ is the eccentric angle EOQ′. At the pole, $x=a-2$, $y=1$, and $\tan\theta=a/b(a-2)$. The area of the sector EQPC is $\frac{1}{2}ab(\theta-\sin\theta\cos\theta)$, and this must be made equal to πR^2 as before. Hence for any value of a we find a corresponding value for R.

The position of any parallel of latitude ϕ is found from the equation $\pi R^2\sin\phi=\frac{1}{2}ab(\theta+\sin\theta\cos\theta)-(a-2)b\sin\theta$.

In the special case where PC is the semi-minor axis of the ellipse, we get the Mollweide projection, $a=2$, $b=1$, $R=\frac{1}{\sqrt{2}}$ and $\pi\sin\phi=2\theta+\sin 2\theta$.

In the *Geographical Journal* for March 1929 (p. 241) a description is given of a projection designed by Mr. S. Whittemore Boggs. This projection may be described as a cross between the Sanson and the Mollweide, and has been called by its designer the "Eumorphic Projection." It can be imitated by an elliptical projection.

In the Eumorphic projection R has the value 0·67094. In the elliptical projection the value of R is determined by the equation $\pi R^2=\frac{1}{2}ab(\theta-\sin\theta\cos\theta)$, where $\tan\theta=a/b(a-2)$. The elliptical projection which imitates the Eumorphic most closely will be that in which R has the same value. Hence we must find values for a and b which make R=0·67094. It has been found by trial that $a=4{\cdot}1620$ and $b=1{\cdot}1703$ are the required values.

The positions of the parallels for this elliptical projection have been calculated, and are given in the table at the end of this paper.

So far, in all the projections, only the 180° meridian has been considered. The other meridians are, in every case, like curves. Thus, all the meridians in the hyperbolic projections are hyperbolas, in the parabolic projection they are parabolas, and in the elliptical projections they are ellipses. In all these projections the parallels are truly divided, and the meridians may therefore be drawn as smooth curves through the points of division.

There is one more projection which may be of mathematical interest. If in the hyperbolic projection we make the eccentricity infinitely great, the hyperbola becomes two straight lines, represented by the equations $x=2y$ and $x=-2y$. The resulting projection is rectilinear. R=0·5642, and the position of any parallel of latitude ϕ may be found from the equation $\pi R^2\sin\phi=2y-y^2$. This projection is easy to draw, but has no other apparent merits.

From the results of the foregoing investigation it is clear that it is possible to construct an infinite number of equal-area projections, which are intermediate between the Sanson and the Mollweide. In all the projections the parallels are straight lines, and the projections are therefore suitable for the climate, temperature, and distribution diagrams which are used to illustrate geographical text-books. The parabolic projection, which is easy to compute and draw, may perhaps be preferred to either the Sanson or the Mollweide.

Amongst all the projections which have been discussed the Mollweide is unique, in that the meridians are continuous curves passing through the poles. In all the other projections there is discontinuity at these points.

DISTANCE OF THE PARALLELS FROM THE EQUATOR

Latitude	*Sanson*	*Hyperbolic nearest the Sanson*	*Parabolic*	*Eumorphic*	*Elliptical nearest the Eumorphic*	*Mollweide*
10°	0·1111	0·1112	0·1163	0·1234	0·1233	0·1368
20°	0·2222	0·2224	0·2321	0·2458	0·2456	0·2720
30°	0·3333	0·3338	0·3472	0·3668	0·3662	0·4040
40°	0·4444	0·4454	0·4609	0·4854	0·4840	0·5310
50°	0·5556	0·5571	0·5735	0·6009	0·5982	0·6512
60°	0·6667	0·6688	0·6835	0·7119	0·7079	0·7624
70°	0·7778	0·7800	0·7919	0·8177	0·8122	0·8620
80°	0·8889	0·8906	0·8980	0·9159	0·9099	0·9454
90°	1·0000	1·0000	1·0000	1·0000	1·0000	1·0000
R	0 63662	0·63662	0·65147	0·67094	0·67094	0·70711

RAINFALL OF SOUTH AMERICA

DIE NIEDERSCHLAGSVERHÄLTNISSE IN SÜDAMERIKA. By BRUNO FRANZE. (Ergänzungshaft zu *Petermanns Mitteilungen*, No. 193, 1927, pp. 79.) 10×7 *inches; maps and illustrations. M.*10

TWENTY years have passed since the publication of a really comparable study of rainfall distribution in South America,* and during this period three sets of circumstances have combined to give an unique value to Dr. Franze's admirable monograph and maps. In the first place, accumulation of data† and advance in the technique of rainfall representation have enabled the author to give greater accuracy and significance to the present work. In the second place, although four studies‡ have appeared since 1907, three of these followed too closely upon the work of Voss, apart from any other considerations, to achieve any important increase in accuracy of delineation, while the fourth, Van Cleef's, was chiefly remarkable for its gross and unwarrantable misrepresentation of conditions over considerable areas of the continent. Finally, the general reliance of writers upon many of the now obsolete conclusions of Supan, Voss, and Hann, would in itself justify the presentation, in accessible form, of a scattered but valuable body of knowledge.

The monograph includes a descriptive text, an exhaustive tabulation of rainfall data, a very complete bibliography and two maps. In spite of intentional subordination of the text to the maps and tables, the former has very distinct

*Voss, "Die Niederschlagsverhaltnisse von Sudamerika," *Pet. Mitt.*, Suppl. No. 157, 1907.

†378 rainfall records in Voss to 3777 in Franze and the publication of detailed regional studies by Davies on the Argentine, Jefferson on Chile, and Carvalho and Morize on Brazil.

‡Emmel, 'Die Verteilung der Jahreszeiten im tropischen Sudamerika.' 1908.
Reed, "South American Rainfall Types," *J. Met. Soc.*, 1910.
Sievers, 'Mittel und Sudamerika.' 1914.
Van. Cleef, "Rainfall Maps of Latin America," *Monthly Weather Rev.*, 1921.

value, both for its critical examination of the data and for its exposure of the peculiarities and problems of rainfall distribution in South America. In regard to the latter, solutions are offered only where a reasonable certainty exists, elsewhere the author is content with an examination of "explanations" in the light of his data, and with a frank statement of insolubility where such is necessary. Practical considerations have necessitated a division of the text into chapters on each of the major political divisions, but the obvious disadvantages of this are largely mitigated by a general summary of distribution and régime in the continent and by frequent reference to areas contiguous to the political unit under discussion.

The map of annual precipitation—unfortunately on the small scale of 1 : 30 million—is constructed with the isohyetal intervals adopted by Voss,* and thus permits of comparison and estimation of progress since 1907. In general, accurate† within the limits imposed by the data, this map, with an honesty characteristic of the whole work, indicates clearly by broken lines those isohyets which are hypothetical. Moreover the relative value of the isohyets is further established by the location upon the map of the great majority of the rainfall stations. The latter feature is most important in view of their most unequal distribution in space. Thus, of the total number of stations, 2136, or roughly two-thirds, lie within the Argentine, whilst Brazil, with some three times the area of that state, has precisely one-third of that number, and of these 50 per cent. at least are located in the seven north-eastern states.

The map representing rainfall régime is on a larger scale—1 : 10 million—and follows the method of indicating seasonal distribution by the plotting of graphs of monthly precipitation for a number of representative stations. It should be noticed that this method, regarded as entirely new by the author, has long since been adopted in American and Australian official climatological publications, and that its merits, delicacy, and continuity of representation have been urged in this country. With its 200 carefully selected graphs the map is effective, and its value is enhanced by a marginal indication of the date of the zenithal position of the sun. However, in view of the discrepancy between the scale of this chart and that of the annual map, it is to be regretted that some, at least, of the annual isohyets were not indicated on the former.

The accompanying map endeavours, by selecting from the isohyets and graphs of Franze, to give the essential features of his work, while the following notes will be chiefly confined to summarizing his conclusions, particularly where these involve a modification of earlier views.

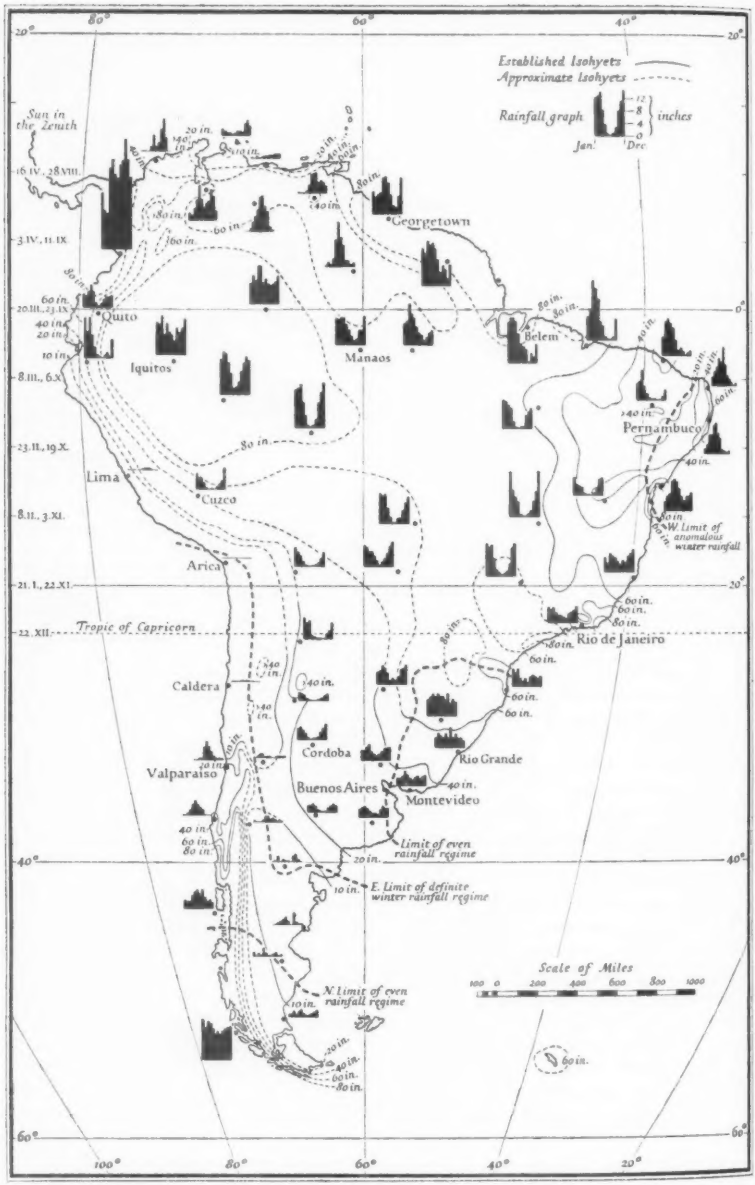
The most striking features of the distribution of annual precipitation in comparison with the results indicated in former continental studies are the abnormal dryness of the Venezuelan coast, the relative dryness of much of the Amazon basin, and the close correlation obtaining between relief and precipitation on the western margin of temperate South America. The first of these features provides yet another commentary upon the ineffectiveness of the Trade-winds as rain carriers except where relief and exposure aid precipitation. Indeed, at sea-level precipitation may be reduced to 10 inches in sheltered locations such as Coro or Cumana, and it only exceeds 25 inches in exposed situations like that of Barcelona (26 inches). The second feature was established by Morize,‡ and emphasized in Jefferson's map,§ but, since it has been ignored

*250, 500, 750, 1000, 1500 and 2000 mm.

†There is, however, one notable slip where a strip of the coast due east of Santa Marta (Colombia) is credited with 2000 mm. instead of its actual 1000 mm.

‡Morize, 'Contribuiçã ao estudo do clima do Brasil,' Observatorio Nacional do Rio de Janeiro. 1922.

§*American Geographical Review*, vol. 14, pp. 127–135.



The Annual Isohyets and Rainfall Graphs of South America (after Franze)

by later writers,* may profitably be stressed. Quite a third of the equatorial area of the basin is seen to have a rainfall of under 80 inches, while of this a not inconsiderable part has under 60 inches, and certain stations, *e.g.* Boa Vista (52 inches), with well-established records show abnormally low totals. The third feature, indicated by the re-entrance and southerly bend of isohyets in the Central Valley of Chile, was stressed in Jefferson's excellent study,† but ignored by Van Cleef.

The most important single feature of the map is the correction of the erroneous, but very generally accepted, conceptions of rainfall régime in equatorial South America. The continent is now seen to be highly abnormal between latitudes 10° north and south in that the normal double maximum and minimum is generally absent or modified in such a way that it is without practical significance. Only in the Cordilleran zone and at two stations—both well outside the appropriate area—does one find the normal equatorial régime. Elsewhere precipitation appears to show a strongly monsoonal tendency and a summer maximum, passing, however, south-eastward through an autumnal to a winter maximum in the zone of marked rainfall anomaly between Cape San Roque and Bahia.

From 10° south to the tropic, with the exception of the small but important area of anomalous winter rainfall on the west coast, and the equally important east coast strip down to 15° S., the continent is normal, since the mass of precipitation occurs in summer.

South of the tropic, four dominant influences are reflected in the map of rainfall régime. Firstly a monsoonal tendency is apparent in the importance of summer precipitation over most of the Atlantic hinterland; secondly, seasonal cyclonic activity, reaching a maximum during the cold season, is either a dominating factor or a subsidiary influence in areas to the north of latitude 45°; thirdly, permanence of cyclonic activity is apparent in the extreme south; while, finally, and in large measure limiting the incidence and importance of the three meteorological factors, is the presence of a complete or almost complete climatic barrier in the Andean chain north of latitude 35°.

As a result of these determinants we may distinguish four primary rainfall types. A. A monsoon type with a marked predominance of summer rainfall limited westward by the Andes north of 35° S., and southward by a line from Chos Malal to Bahia Blanca. B. A winter rainfall type extending along the Pacific coast from 18° to 45° S., and strictly limited eastward by the Andes north of 35° S. South of that latitude, the lessened height and continuity of the chain permits of an eastward passage of Pacific moisture in winter, which appears as a dominating influence in an area bounded on the north by the Chos Malal line and on the south by a line from Isla Magdalena to Canadon. C. A type with a very even distribution of precipitation in the area of permanent cyclonic activity and occupying the southern extremity of the continent south of the Isla Magdalena–Canadon line. D. A type with even precipitation, this time resulting from the interaction of summer monsoonal and winter cyclonic activity and occupying the greater part of Uruguay and Southern Brazil.

Although each type is quite distinct in the centre of its area, it should be noted that only in the case of the boundary between types A. and B. to the north of 35° is there any sharp demarcation between the zones occupied by them; elsewhere transition is more obvious than either the boundary-lines or the small number of graphs here reproduced would imply. H. A. MATTHEWS.

*Hann-Suring, 'Lehrbuch der Klimatologie.' 1926.

†American Geographical Society, Research Publication No. 7. 'The Rainfall of Chile.' New York, 1921.

WILLIAM DAMPIER, GEOGRAPHER

WILLIAM DAMPIER. By CLENNELL WILKINSON. (The Golden Hind Series.) John Lane, The Bodley Head, 1929. 9×6 *inches;* 258 *pages; illustrations and facsimile maps.* 12*s* 6*d*

THIS book is the most important contribution to our knowledge of William Dampier, buccaneer, explorer, and hydrographer, which has appeared since 1906, when Mr. Masefield published his notes to a new edition of Dampier's 'Voyages.' Mr. Wilkinson has studied much material in the Public Record Office unused by former biographers, and thereby has thrown fresh light on Dampier's career. He has also produced, from the somewhat confused and scattered evidence available, a consecutive and readable account of Dampier's wandering life.

The work would have been of greater value had more references been given in footnotes; it is often difficult to hunt down the source of a particulat statement, and the book seems to be written for the "general reader" rather than for the serious student. But, in spite of this weakness and of certain inaccuracies and other blemishes which will be criticized later, my opinion on the whole is favourable. Certainly the story makes good reading.

Dampier's early voyages—to France, Newfoundland and the East Indies—were followed by service in the Dutch War. Next he went to Jamaica, to take charge of a plantation belonging to Colonel Helyar. Then, after visiting the logwood cutters of Campeachy Bay, he joined them for a time. But, the settlement being ruined by a great storm, he was forced to take any other employment which offered, and thus came to join "the privateers." These men were not pirates. As Mr. Wilkinson says, "the rise of the buccaneers was an insurrection of all the discontented elements in the West Indies, directed primarily against the Spanish rule. They fought both by land and sea. They were formidable foes. The Pirates were their unworthy offspring."

With these men Dampier sailed and marched, as he himself says, "more to indulge my curiosity than to get wealth," taking some Spanish ships and towns, and being repulsed from others. Then, joining Swan when he separated from Davis, Dampier discussed with his Captain a voyage to the East. The two persuaded the crew with hopes of plunder, and crossed the Pacific. Landing with a few companions at Nicobar, Dampier reached first Sumatra after a dangerous canoe voyage, and then the English Factory at Achin. Thence he sailed to Tonquin, next as mate of a trading ship to the Dutch Islands, then to Madras and many other places, and finally returned to England in 1691, after an absence of twelve years. He had been led on from one adventure to another by his insatiable desire to see the World—"knowing that the farther we went the more knowledge and experience I should get, which was the main thing I regarded." But he was almost penniless, and had little more to show for his circumnavigation of the Earth than the leaves of his Journal, preserved through all dangers and misadventures, and a half share in a native whom he had brought home.

He had to sell his share in "the Painted Prince " for ready money, but the Journal found a publisher. The book of Voyages appeared in 1697, and ran into three editions within a few months. Our obscure sailor, by his adventures and his literary power of describing them, had become famous. But there was also solid scientific achievement, which gave Dampier a reputation better worth having. Charles Montagu, the President of the Royal Society, afterwards Lord Halifax, Sir Robert Southwell and Sir Hans Sloane befriended him, and his expert knowledge was drawn upon for official use. Moreover, apparently by

request, he put before the Admiralty a proposal that one of the King's ships should be fitted out and sent to explore the coasts of New Holland, *i.e.* Australia. In 1698 he was himself commissioned to carry out this project. It is true that the ship they gave him was small and in bad condition, but nevertheless here we have the first attempt at a voyage planned for the deliberate purpose of scientific exploration, the progenitor of the voyages of Cook, of the *Beagle*, of the *Rattlesnake*, and of the *Challenger*.

Dampier set sail in the *Roebuck* in 1699. Mr. Wilkinson does full justice to his geographical discoveries, not rightly appreciated by historians: discoveries which would have been greater with a little better luck. When the *Roebuck* reached the shores of North-Western Australia, had it not been for his instructions from the Admiralty and, perhaps, his own predilections for a "warm voyage," Dampier might have turned south and anticipated Cook by three-quarters of a century. Instead, he discovered much territory along the northern coasts of New Guinea and the neighbouring islands; indeed, as Mr. Wilkinson says, "the map is very largely his about here." Again, he might have reached South Australia by the east coast, had not the state of his ship forced him to turn homewards by a known route. And, in spite of all efforts to keep her afloat, the *Roebuck* sank off the island of Ascension.

At the beginning of the voyage there had been trouble with the crew. Dampier had moreover quarrelled with a mutinous lieutenant, Fisher, and in the end had to put him ashore at Bahia in Brazil, where for a time he was imprisoned by the Portuguese. At Fisher's instance, Dampier was court-martialled on his return to England on a charge of cruel usage. Although the verdict on some counts was adverse, and the Court expressed the view that Dampier was not fit to be Captain of one of the Queen's ships, the fact remains that he was soon given another command. The authorities paid no heed to that part of the verdict; indeed, they seem to have expressed their disapproval of it in a marked manner. Ten months later, the London Gazette records "Captain William Dampier, being prepared to depart on another voyage to the West Indies, had the honour to kiss Her Majesty's hand, being introduced by His Royal Highness, the Lord High Admiral." Mr Wilkinson holds that Dampier must have been a very bad witness at the court-martial, but that the verdict did him no harm.

Nevertheless, as his latest biographer, like some earlier ones, realizes, Dampier had not the faculty of command. He was both happier and more successful in the later years 1708 to 1711, when piloting Woodes Rogers round the World, and this, his last voyage, unlike his early ventures under the buccaneers, and those when he himself was in command, brought him in considerable profit. Mr. Wilkinson says that the real clue to his character is that "he was not by nature a man of action, but an artist and a dreamer." With the first part of this estimate I agree, but the second, I think, misses the point. Dampier was essentially a man of science, with an intense curiosity with regard to the workings of nature; and this was the real passion of his life. He was largely self-taught, and found his true work only amid a host of difficulties. But not only did he make and record accurate observations on the physical geography and the flora and fauna of the countries he visited, but he made notable advances in our knowledge of hydrography, of meteorology, and of terrestrial magnetism. When, later in life, he became acquainted with the leaders of contemporary scientific thought, he found himself for the first tine in congenial society, which appreciated him at his true worth. He was not a success either as a buccaneer or in command of a King's ship, but as a man of science, able, as many men of science have been, to express his results clearly and in good literary style, he ranks high in the list of famous Englishmen. On this side of Dampier's life—and it is the most important side—Mr. Wilkinson's study, which gives but a

meagre account of his scientific work, is very inadequate. The true life of William Dampier, the man of science, remains to be written.

It seems unfortunate, also, that Mr. Wilkinson did not get into communication with the present members of the Dampier family. He might have saved himself some trouble and been given information he has been unable to obtain.

The correct date of Dampier's birth, 1651, which Mr. Wilkinson makes some point of having discovered by a study of the East Coker Parish Registers, was noted from the same source, and printed in a local Journal in 1907, and again in 1928 in *Notes and Queries*.

The manuscript proceedings of the Court-Martial in the Public Record Office, read by Mr. Wilkinson, were studied some twenty years ago by Admiral Dampier, who, I am sure, would readily have placed at Mr. Wilkinson's disposal both his notes on the evidence and his expert opinion on the whole affair. I think that opinion is worth recording, and, with Admiral Dampier's consent, I quote from recent letters:

> "The Court was composed of Admiral Sir George Rooke, President, Admirals Sir Cloudesley Shovel, Thomas Hopson, and Sir Stafford Fairbourne, and 33 Captains—a truly formidable array for even a hardened Buccaneer to face—no wonder that his evidence wasn't particularly good. I also noted that the evidence produced by Fisher was almost entirely that of seamen, whilst that called by Dampier was largely that of officers, though the latter was somewhat discounted by the fact that one of them, Jacob Hughes the Master, appeared to be a drunkard, whilst another, the Pursar, was concerned in some rather questionable transactions about stores. However, I agree with the Court 'that Dampier was not a fitt person to be employ'd as Commdr. of any of Her Majesty's ships,' though I daresay he wasn't a bit worse than heaps of others who were thus employed. But the whole impression left on my mind after reading the evidence was that if I had had such a mutinous Lieutenant as Fisher, I would have had him out of the ship one way or another before I left Gravesend. . . . I have always considered the sentence (fining Dampier 3 years' pay, etc.) a very hard one. . . . It seems to me that the Court did not take the trouble to consider whether the voyage, which was one of discovery paid for by the Admiralty, had yielded any results. It was possibly for this reason that the Admiralty, in the person of the Lord High Admiral, introduced him to the Queen before starting him on his next voyage."

Again, in his account of Dampier's origin and family, Mr. Wilkinson says:

> "The Dampiers seem to have been fairly substantial folk; but what was the size and distribution of the family and what became of them—whether, for instance, that Dr. Dampier who was promoted by George III to the Deanery of Rochester in 1782, and whose son was made Bishop of Ely, came originally from East Coker, I am unable to say. Nor does it matter much."

Perhaps not. But, as Mr. Wilkinson says on p. 10 in another connection, "If we are going to mention" such a detail "at all, we might as well get it right." I take this opportunity of saying that Dr. Dampier, Bishop of Ely, was not the son of the Dean of Rochester, but the Dean himself—his father was Dean of Durham, not Rochester—and that he did not come from East Coker, but was one of the Dampiers of Blackford, and afterwards of Colinshayes, near Bruton. Mr. Wilkinson would have found an account of what is known of the origin and inter-relations of the family in *Notes and Queries* for 31 March 1928, where is reproduced the substance of a fuller discussion which appeared in 1906/7 in *Somerset and Dorset Notes and Queries*, vol. x, pp. 85 and 337.

W. C. D. DAMPIER-WHETHAM.

THE PENN COUNTRY AND THE CHILTERNS. By RALPH M. ROBINSON. Illustrated by CHARLES J. BATHURST. *London: John Lane, The Bodley Head Ltd.* 1929. 10×7 *inches; 212 pages; and illustrations.* 15*s*

The author and illustrator have produced an excellent book intended chiefly for the intelligent pedestrian. They describe "The Penn Country" and the Chilterns, laying stress on the beautiful out-of-the-way places into which the threatening evils of the bungalow growth have not yet penetrated. The man or woman who can leave behind the motor-car and trust to feet has in this region a wealth of natural loveliness to feed the eye, and the impress of historical persons is set deeply on valley and upland. Little of the lore of the district is left untold, few sequestered by-ways seem to have been untraversed, and everywhere the author has obviously seen and read with an infectious enthusiasm. His pages represent the carefully prepared rambles of many years: it is obvious that this is the work of an eye-witness who is also a diligent searcher in records and a collector of enlivening anecdotes. To crown all, the author is the master of a good style, and can feelingly describe the sights and sounds of the country-side. We can commend his book as a valuable guide to the intimacies of the region.

SUSSEX. By JOHN H. FORD. 1929. 140 *pages.* 4*s*

YORKSHIRE. By F. R. PEARSON. 1928. 174 *pages.* 4*s* 6*d*

(The Borzoi County Histories.) *London: Alfred A. Knopf.* 8×5 *inches; illustrations and maps*

This simple historical narrative of Sussex through the ages, from prehistoric times to the Industrial Revolution and the Sussex of the seaside fringe and motor-car roads, is well told by Mr. Ford, and illustrated by photographs of the really salient things. The facts are packed somewhat tightly, and yet the pages read easily. Nothing of importance seems to have been omitted.

Yorkshire, the big county of castles and abbeys, is attractively described and illustrated on the same lines by Mr. Pearson, whose pages have an appreciative foreword by Dean Inge. To all that concerns the scenery, the political and social history, and the great men of the county, the author is quite alert, and we note that he has brought his information up to date. There are place-name glossaries to both volumes.

THE DOONE VALLEY AND THE WATERSLIDE. By ALFRED VOWLES. *Minehead: Cox Sons & Co.* 1929. 7×4 *inches; 26 pages; illustrations and sketch-maps.* 1*s*

In view of the fame of the Doone Valley and the Waterslide of R. D. Blackmore's 'Lorna Doone,' and of the number of visitors who make a pilgrimage there to be disappointed, Mr. Vowles has issued a little pamphlet, the object of which is to help to a better understanding and appreciation of the site. He traces the history of the ancient village of Badgworthy, describes, with plan, the ruins now existing, compares the actual waterslide with Blackmore's descriptions of it, and gives a useful sketch-map of the easiest route from Oare rectory to the Doone Valley.

ROMAN ESKDALE. By R. G. COLLINGWOOD. *Whitehaven: The Whitehaven News Ltd.* (1927). 9×5 *inches; 52 pages; illustrations and diagrams.* 1*s*

The valley of the Usk in Cumberland is rich in Roman remains, notably the forts of Hardknot, with its exceptional parade ground, and Ravenglass (? Clanoventa) on the coast, and a pottery and tilery near Eskdale Green. Mr. R. G.

Collingwood very clearly, simply, and feelingly describes these in a well-printed shilling guide-book, the matter of which has already appeared in the *Transactions* of the Cumberland and Westmorland Antiquarian and Archaeological Society. Plans and photographs accompany the text, but a sketch-map of the district is much to be desired. Roman Eskdale, the author argues, is Agricola's work, as part of the Lancaster—Ambleside—Ravenglass strategic road, the purpose of which was purely temporary, in connection with Agricola's unrealized scheme of invading Ireland from Ravenglass. For the first time the general public is given access to a businesslike account of Hardknot Castle. This is a model guide-book to Roman sites. S. E. W.

THE HIGH PYRENEES: Summer and Winter. By BECKET WILLIAMS. *London: Wishart & Co.* 1928. 8×5 *inches; 214 pages; illustrations and map. 7s 6d*

What amusement and physical recreation are offered to the traveller in the High Pyrenees in both summer and winter seasons is here gaily told by Mr. Becket Williams, who has so obviously and so thoroughly enjoyed his many long stays in the region that the reader is bound to share his personal enthusiasm. His pages are both entertaining and informative. From Pau to Luchon, and from Laruns to St. Gaudens is the district covered, and Bagnères-de-Bigorre, Payolle, Luchon, Luz, Barèges, Gavarnie, Laruns, Eaux-Chaudes, and Eaux-Bonnes are among the places described. Some twenty pages on winter sports will appeal to many who would welcome a change from Switzerland, and a note on motoring is most useful. Mountain scenery is attractively illustrated by good photographs. This is a practical and entertaining guide-book.

THE HIGH STREAM OF ARUNDEL. Edited by JOSEPH FOWLER. *Littlehampton: Nature and Archaeology Circle.* (Extra publication No. 1.) 1929 10×8 *inches; 72 pages; and map*

The rivers and small streams of England as a whole receive but scant attention from our writers, though for a really intimate knowledge of a county there is nothing that can compete with the following of its waters. An attractive general survey of the streams of Sussex appeared about the middle of last century in the Sussex Archaeological Collections, but Mr. Fowler's delightful archaeological excursion goes into the detail of the river Arun in a unique manner. He has printed and edited for the first time an old water-bailiff's book of about the date 1636, and by walking the country and diligent inquiry has been able to add greatly to our knowledge of the history of estates, houses, roads, and bridges. It is difficult to describe the chatty style of the MS. except by sample. "The first Branch, or Head thereof, ariseth in the East part of St. Leonard's Forest in Bramber Rape in this County, at a Place near Slaugham, (late the Seat of the Coverts of Knights degree, whose ancient dwelling was at Sillington in Bramber Rape), at a place called Daukers Lawnes, being there a small Gilly or Current easily to be step'd over, which runneth thence into a Pond below, where standeth an Iron-work, part in the said Forest, and part in Nuthurst Parish, where it meeteth with another Current that riseth in Sibbills field in Beaubush, and part of it in Shelly adjoyning, where stood sometime Shelley Chapel, now defaced, (being a Chapel of ease belonging to Slaugham aforesaid, but now annexed by Stat. 2° H. 6th to Crawley not far from it). From hence this branch runeth through Hawkins Pond, on the Head or bay whereof there stood sometimes an ancient Chapel, now naught but ruinous, dedicated to St. Leonard, whose Festival is solemnized about the beginning of November, from whom this Forest took its Name, within the Compass whereof (which is of large extent,

about 11,000 acres or more) is scarce at this day, though I have enquired of many old Inhabitants, yet as far as I could ever learn, an Nightingale heard to sing, if at all, never since (if the Tradition be true) she was by St. Leonard, for her unseasonable disquieting of his devotions, interdicted the Courts thereof." This is a charming sample of seventeenth-century country lore, well edited and well produced. S. E. W.

PREHISTORIC SUSSEX. By E. Cecil Curwen. With a Foreword by O. G. S. Crawford. *London: The Homeland Association*, 1929. 9×6 *inches;* xii+172 *pages; illustrations, diagrams and maps.* 10*s* 6*d*

The author has written an excellent book on prehistoric Sussex, and one that will be of great use to archaeological students of many types. He has good qualifications for undertaking such a task. He has been through the mill of field archaeology, though perhaps the figure of speech is not quite apt for one who has spent delightful holidays under canvas while digging out knowledge and who has obviously done his work *con amore*. He has the mind of a scientist: is accurate, patient, and cautious, and ambitious to advance knowledge. As a writer, he has the knack of interesting his reader, and condescends to put his facts and theories simply. He has used to good effect the latest device of photography of archaeological sites from the air. It was time that somebody should attempt to summarise knowledge on this subject, and, though a comparatively young man, Mr. Curwen was the man to do it. He deals convincingly, as only a writer with first-hand knowledge can do, with the flint-mines of Sussex (on Blackpatch, Harrow Hill, Cissbury and so on), burial mounds, hill-forts, villages and cultivations, Roman and prehistoric roads, and miscellaneous earthworks, and rounds off his pages with a few good hints on the detection and mapping of earthworks. The accompanying photographs, drawings and diagrams are truly illustrative: notably plate xv, an air photograph of the Trundle, Goodwood, which first called attention to the inner neolithic earthworks.

Attention may be called to a few points. Little as is known about prehistoric trackways, the author seems to have convinced himself that a chief characteristic was their sinuosity, which he connects with "that appreciation of curved lines which has made Celtic art unmatched throughout the world." We suggest that the art-loving prehistoric Celt when drawing lines with a stick on an unbaked pot was in a different frame of mind from the hungry and tired Celt making on foot for his destination. Common sense impelled the latter, as it does the modern tramp in search of work, to go as straight as possible. A desire to reach the lowest practicable crossing of the Thames from the coast where now are Hastings, Rye and Winchelsea, would surely have dictated his passage along the ridges via Tonbridge and Sevenoaks on the line of the modern Hastings road. No doubt a Roman road between these points would have been a trifle more direct and scientific, but there would, we think, have been only a small difference in mileage between Celtic and Roman routes. That Cogidubnus inhabited the Bignor villa is highly improbable. The strong walls of Anderida may not have been built till the early fourth century, but it is highly probable that the place was used as a harbour by the Roman "British fleet" long before. The polygonal shape of the walls of Chichester is insufficient evidence for supposing it to have been a Belgic city. On this point the author advances from possibility to certainty in one page: on p. 6 he states that the ramparts have been attributed to the Belgae, but on p. 7 Chichester is categorically a Belgic city. On p. 102 we read "one Pudens gave a plot of ground . . . this fact is recorded in an inscription." The name Pudens is not a fact, but an assumption: the inscription is deficient, and gives only -ente, the termination of the name. The evidence for the date of the working

of the flint mines is arrayed on pp. 20 *et seq.*, and the author concludes that it was some 2000 years B.C., but his seven or eight points in support of this conviction together amount to evidence which is very tenuous; nor does the repeated assertion of date "four thousand years ago" on three successive pages (17, 18, 19) really win credence for his conclusion. It is not proved that the inner stone wall at Saxonbury belongs "to the century immediately preceding the Roman period." S. E. W.

A WAYFARER IN THE PYRENEES. By E. I. ROBSON. With twelve illustrations by J. R. E. HOWARD. *London: Methuen* 1929. 8×5 *inches;* x+216 *pages.* 7*s* 6*d*

This volume in Methuen's Wayfarer Series is the work of a traveller who knows his subject well. It is not intended for mountaineers, but for the general tourist, and it is, as it should be, practical, sensible, and informing. The traveller is fortunate who can make his first acquaintance with the district in Mr. Robson's company, while those who are unable to do so can renew a host of memories without stirring from their chairs. The illustrations deserve a special word of commendation, and the sketch-map is just sufficiently detailed to supplement the text. M. L.

LES ROUTES DE FRANCE. Etude Bibliographique sur les Cartes-Routières et les Itinéraires et Guides-Routiers de France. Suivi d'un Catalogue des Itinéraires et Guide-Routiers 1552–1850. By Sir GEORGE FORDHAM. *Paris: Honoré Champion* 1929. 9×7 *inches;* 106 *pages*+60 *plates.* 60 *francs*

Sir George Fordham did not look to a large public for his works, but this last study throws an interesting light on the development of travel literature to meet the growing needs of the tourist and traveller. The instinct to see the world, which at first found its dignity and justification in crusading, and in the performance of pilgrimages, had grown by the sixteenth century into something which approaches the modern tourist spirit. A desire to fill the eyes and the mind with strange sights and experiences took the place of devotional and crusading travel. The claims of France, at first a little overshadowed by Italy, could not be withstood, and there is little doubt that the enterprising printers who produced the itineraries and road-books enumerated here had a keen eye for the demands of the foreigner. The reader can trace the main currents of the trade in guide-books, from the earliest itinerary issued by Charles Estienne in 1552 to Murray's 'France,' which first appeared in 1843. The author's introduction is a model of its kind, but it is sad to think that we shall have no more of these familiar studies in travel literature. M. L.

BUCH DER LÄNDER: LANDSCHAFT UND SEELE DER ERDE. Das Buch Abendland. By EWALD BANSE. *Berlin: August Scherl:* 1929. 9×6 *inches;* 429 *pages; and diagrams.* 10 *Marks*

Herr Banse's avowed task is to present the facts of European geography from a fresh standpoint. He accepts the view that the study of geography has reached a turning-point—that it has passed through the analytical stage, in which the contributions of the allied sciences have been determined. As he sees it, the task of the geographer is now to build up an individual representation of each country. His own travels in the Near East impressed upon him the close relationship between human societies and their environments: what he really is aiming at in this book, broadly, is to make the contrast between France and Germany, for example, as definite in his readers' minds as that between Anatolia and England. Such a treatment of Europe raises obvious difficulties: not only are the differences smaller, but geographical conditions are not limited by

political boundaries. This is probably one reason why he introduces so much historical and social matter, for in this way the countries of modern Europe can be further differentiated. This proportionately large amount of history appears in fact to be the main feature of this geographical method. His point of view is undisguisedly nationalistic, though he does not hesitate to criticize his own countrymen. He dilates upon the present discrepancy between the "Staatsraum," the area within political Germany, and the "Volksraum," the land of the German people, which he stretches to the widest limit; and it is one of his objects, by arousing and directing German opinion, to expedite that moment when the limits of "Staatsraum" and "Volksraum" will coincide. G. R. C.

THE VOYAGE OF THE *ANNIE MARBLE*. By C. S. FORESTER. *London: John Lane, The Bodley Head Limited* 1929. 7×5 *inches;* 277 *pages;* 39 *illustrations, and a map.* 8*s* 6*d*

Tarmac surfaces, concrete kerbs, and garish filling stations have knocked the romance out of our roads. For those curiously rare spirits that do not care to line up in a procession of touring cars there are still available nature's highways, the rivers; and in France there are hundreds, if not thousands, of miles of waterways navigable for a small boat like the 15-foot punt-built dinghy, with outboard motor, which is here so lovingly described. The author and his wife made it their home for eleven weeks, during which they voyaged from Rouen up the Seine to St. Mammès above Fontainebleau, then by the Canal du Loing and the Canal d'Orleans to the Loire and down that sprawling flood to Nantes. And all, apparently, at ridiculously small cost! On the upward part of the voyage they frequently saved their own power by accepting a tow at the tail of a string of barges, and thereby made the acquaintance of the kindly, honest, and polite race of French bargees; on the downward part they saved power by drifting in the labyrinth of swift but shallow channels. What more delightful way of spending a holiday than this, which has just that spice of adventure and sense of exploration that a real holiday should have? And what more novel or charming view-point for seeing even a well-known country and familiar objects? We cannot be too thankful to the author for abstaining from descriptions of the Seine churches and the Loire châteaux, though among his photographs, which on the whole are interesting but not very good, he has had to throw in Chambord and Chaumont. Let us assure him, by the way, that there are many more than a dozen pre-Gothic churches in England. J. H. R.

THE OLD-WORLD GERMANY OF TO-DAY. By GERALD MAXWELL. *London: Methuen & Co. Ltd.* 1929. 8×5 *inches;* xii+180 *pages; and illustrations.* 7*s* 6*d*

Mr. Maxwell writes pleasantly and with knowledge of some of the lesser-known German cities. Many English visitors are familiar with Nürnberg, Rothenburg, and Frankfurt, but Schwäbisch-Hall, Goslar and Hildesheim are off the beaten track. Hildesheim has some of the loveliest old houses to be seen anywhere, and as for Goslar, every stone in its streets is alive with history. Mr. Maxwell also includes in his survey Dinkelsbühl, which is becoming better known, Würzburg (where he gives us an excellent appreciation of that great sculptor Tilmann Riemenschneider), Hanover, Celle, Halberstadt and Heidelberg. He seems happier among artists than historians, but he has much to say by way of introduction to a delightful subject—the study of the mediaeval German cities. His photographs are excellent. M. L.

BIARRITZ, PAU, AND THE BASQUE COUNTRY. By ARMAND PRAVIEL. *London: The Medici Society* 1927. 8×6 *inches; 172 pages; illustrations and sketch-map.* 7*s* 6*d*

This is another volume in the Picture Guides Series. As in the previous volumes the photographs are excellent and the text is the work of an enthusiast, but it suffers a good deal in translation. English readers might have been spared the highly coloured description of the torture and slaying of wood-pigeons, which is a grave blot on the amenities of this part of France. M. L.

BEITRÄGE ZUR HISTORISCHEN GEOGRAPHIE, KULTURGEOGRAPHIE, ETHNOGRAPHIE UND KARTOGRAPHIE, VORNEHMLICH DES ORIENTS. Herausgegaben von HANS MŽIK. *Leipzig u. Wien: Franz Deuticke* 1929. 10×7 *inches;* iv+202 *pages; plates and diagrams.* 25 *marks*

This collection of studies was presented to Dr. E. Oberhummer of Vienna on the occasion of his seventieth birthday. In compliment to him it is devoted to various problems in the historical geography of the Orient, and has more unity than is usual in works of this description. The first essay, however, stands somewhat apart from the others: in it Dr. K. Ausserer describes at length the history and contents of the uniquely augmented copy of Blaeu's great Atlas published in eleven volumes, but enlarged by the addition of many MS. maps and views to fifty volumes, and now in the Vienna National Library. It was prepared by Laurentius van der Hem, a seventeenth-century burgher of Amsterdam, as a memorial to his brother. The two thousand odd sheets are particularly concerned with the Dutch East India Company's spheres of interest, but many other countries are represented, including the British Isles, Provence, and Southern France. Van der Hem was a great traveller, and made the most of his opportunities for gathering material for this collection. Among the many artists are Willem Schellinks, with Southern European and English subjects, and Reiner Zeeman with North African views. Dr. Ausserer gives a brief analysis of the contents, and will publish the results of his further researches into this monument of Dutch cartography.

Most of the other contributors attack obscure points in the history and cartography of South-East Asia. Considered together, they emphasize certain points very strongly: for example, the lasting influence of Ptolemaic conceptions, the hold of Alexander the Great upon the imagination of Arabs, and the confusion which arises in attempting to solve problems of nomenclature from the frequency with which succeeding generations of writers have transferred names, generally to more distant features. That theories based upon these later identifications are likely to be seriously at fault is the thesis of Dr. A. Herrmann's discussion of the "Tartessos" and allied problems. He argues in considerable detail for the situation of Tartessos in the west of the Syrtis Gulf, rather than that in South-West Spain favoured by other writers. In an essay of more general interest, 'Das Meer im Geschichte und Kultur des Islams,' Dr. H. Jansky shows how the Islamic peoples, with their continental, nomadic outlook, exemplified in the Koran, have never taken kindly to maritime enterprise. This failure enabled the Byzantine Empire to withstand their assaults for centuries: the Arabs' sole footing on the northern shores of the Mediterranean was won in the extreme West, where they could inflict little harm upon the Empire. The naval record of Seljuk and Ottoman was largely a succession of disasters: piracy is not admitted as proof of sea-power, but rather as evidence of the failure of large-scale operations. The writer acknowledges two exceptions to this failure to expand overseas—the Arab penetration of the East African

coast, and in Malacca and Sunda. This powerlessness on the seas he regards as one of the most difficult of the problems confronting Islam to-day, for while handicapping development it has also permitted adversaries to seize and hold many of the borderlands of the Islamic world.

These references to the attitude of true believers towards the encircling ocean are strikingly illustrated by Dr. H. Mžik's essay on the Arab geography of South-East Asia. He has carefully reconstructed a map from the data in Al-Huwarizmi's 'Kitab surat al-ard,' or 'Book of the maps of the world,' a version of Ptolemy's 'Geographia.' A comparison with maps from the latter's data shows that, since Al-Huwarizmi accepted Ptolemy's figure of 180 degrees for the extent of the inhabited world, but reduced his longitudinal extent of western features, especially the Mediterranean, he had an empty area of 16 to 18 degrees on the eastern edge to fill in. This he did partly by duplicating Ptolemaic features, and partly by incorporating legendary or semi-legendary elements. Thus a long eastern peninsula was evolved from Ptolemy's Cattigara, the most conspicuous detail of which is three further peninsulas joined to the eastern edge by narrow necks and lying in the "Sea of Darkness." These were in reality islands drawn by Al-Huwarizmi out of the Alexander-myths, though one undoubtedly reflects some knowledge of Ceylon. Alexander was thought to have visited all these spots, but, since the "Sea of Darkness" was held to be impenetrable, the islands had to be converted into peninsulas to satisfy all the requirements.

The influence of Ptolemy and Alexander upon the Arabs is suggested in the 'Sailing Book' or 'Bahrije' of Piri Re'is. Prof. Kahle, who has already published one version, has since been able to study another MS. of greater length. In this Piri Re'is professes to derive much of his information from the 'Franks,' ultimately even from Alexander, whose work had been translated by Ptolemy! The book also shows some infiltration from Chinese sources, though through what channel is obscure.

It is possible here to refer only to a few of the remaining studies. R. Heine-Geldern treats of the references to the Ganges Delta in the 'Periplus' of the Erythrean Sea; K. Krause, as a preliminary to the study of Ptolemy's terminology, examines his philosophic affinities; Dr. Christine Rohr reports the discovery in the Vienna National Library of MS. accounts in Portuguese and German of Da Gama's second voyage to India, which through an inaccurate catalogue entry have hitherto been overlooked. G. R. C.

ATLAS OF FINLAND, 1925, issued by an Editorial Committee under the direction of the Geographical Society of Finland. *Helsinki: Otava Publishing Company* 1929. English text contained in Vol. 48 of *Fennia*. iv +320 *pages; illustrations and sketch-maps. Text alone, F. Marks* 90; *text with atlas, F.M.* 550

This new and revised edition, text and atlas, is one of those immense pieces of work which requires a staff of expert workers, involves years of labour, and should, as a valuable work of reference, be found in every important library. A monument of faithful toil and remarkable achievement, it will be welcomed not only by those who seek information, geographical and scientific, about Finland itself, but also by that wider public, interested in the genesis and evolution of a modern commonwealth. Almost the first feeling, on turning over the leaves of this large but attractive volume of maps with its slim accompanying text, is keen regret that other nations have not adopted a similar comprehensive method of making themselves known.

Considering first the atlas, we at once notice an appreciable reduction in the number of map-sheets as compared with the 1910 edition. This does not, in most cases, mean that omissions have been made, but that the material, having

been collected and tabulated for a longer term of years, could be more efficiently and scientifically handled, one map presenting the features of several in the older atlas, more graphically and with equal clearness.

An example of this skilful handling is seen in the method of dealing with agriculture, the most important industry. By reduction in size of some of the maps, it is here presented in 39 phases and statistical tables as against 22 in the older edition, and yet fills only the same number of map-sheets. Meteorology again, requiring formerly four map-sheets of 42 maps, is now more concisely dealt with in one map-sheet with 18 maps. Another example of actual gain in simplicity and directness is seen in the comparative maps showing different phases of the sea with the data relating thereto, these being now displayed on one map-sheet instead of the three and a half originally allotted. Expansion is, on the other hand, observable in parts dealing with the various aspects of educational activities, these occupying now 17 map-sheets as compared with one in the older atlas and two in its text.

The very numerous additions and improvements in the present, as compared with the 1910 edition, more than compensate for the omissions, the latter consisting mainly of maps concerned with special geological or archaeological subjects which, being in the main unchanged, can be equally well consulted in the older work. Of the many new features in the atlas, the most important, beyond those above mentioned, will be touched on in the order in which they occur, not necessarily that of merit.

The map on a scale of 1/M (four sheets), for which Professor Granö has been mainly responsible, is excellent in every way, the difficulty of nomenclature having been referred to a committee of experts. An index of place-names would have enhanced its general utility. The bathy-orographical map of the previous edition could hardly be improved; it has, nevertheless, gained by the inclusion of the Petsamo region and by the addition of the marine bathymetric data determined by Rolf Witting. The map of ancient rocks is specially interesting as embodying the more recent investigations carried out by Professor Sederholm or under his direction. The importance of these, as throwing fresh light on the involved inter-relations of the most ancient rocks composing the Earth's crust, will be appreciated, not in Finland alone but everywhere that these rock-formations occur.

Another new feature is map-sheet 19, setting forth Professor Granö's special method for the precise definition of geographical regions. A generally accepted nomenclature for exact description of landscape in different categories according to type is urgently needed in geo-morphological work. It is doubtful, however, whether a method that seems adequate here, and in Estonia, would prove equally applicable in regions of widely divergent type; moreover, the use of formulae in such connection is confusing. The maps of special areas are so beautifully rendered as to need no description.

In the latter part of the work, touching more particularly on the national life, one marvels, not only at the perfection of organization that has enabled so vast a quantity of statistics to be amassed and collated, but also at the completeness of departmental administration that has been, in so short a time, evolved. The arrangement of the maps has here been considerably improved. Those, for instance, showing the incidence of defects and diseases have been reduced in size and placed nearer the end of the work, their place being taken by others illustrative of new anthropological and ethnographical information given in the text. These deal on the one hand with details relating to race, language, etc., and, on the other, with the distribution of building-types, both boat and vehicle, of agricultural implements, and even of staple food-substances, including the ubiquitous *fil* (sour milk).

Only one omission is noted with regret, and that is due to method and not to lack of material. In describing the fauna, the actual prevailing types are mentioned so that a mental picture can readily be formed; the flora, on the contrary, is adequately described as to zones and numerical distribution, but neither atlas nor text gives any hint as to the actual composition of the floral carpet, except for the trees and mosses, yet this plays an important part in many landscapes.

In spite of its reduction in bulk the text contains, as revealed by the above description of the atlas, much new matter, and has been carefully brought up to date by expert work along every line of investigation represented therein. The reduction in bulk, from two volumes of 500 odd pages each to one volume of 320 pages, is not due, as already shown, to the larger page and reduced print only, but also to judicious omissions. These consist largely of the parts describing the historical development of each line of research, which can be as well consulted in the older edition. The combination of these and other omissions, including all illustrations of scenery, with a more definite systematization of data, has rendered much condensation possible. The chapter devoted to neighbouring seas, for instance, was somewhat diffusely treated in 87 pages of the older edition, but is here concisely dealt with in 7½ pages.

The outcome of all this labour is a neat workable volume of text forming a most useful adjunct to the larger atlas. E. G. W.

ITALY. By LUIGI VILLARI. (The Modern World: A survey of Historical Forces. Edited by the Rt. Hon. H. A. L. FISHER.) *London: Ernest Benn* 1929. 9×6 *inches;* 392 *pages; and map.* 18*s*

Commendatore Villari writes as an ardent champion of Fascism and naturally his outlook colours his interpretation of the facts, especially on the historical side of his work, such as in his account of political life under the old system. Whatever one's views, no fair-minded person can deny that parliamentary government never really thrived on Italian soil. However this may be, the book before us gives an admirable, well-informed description of post-war Italy and the rapid progress the country has made, notably in the development of water-power, the reclaiming of waste land, and the encouragement of industries. Of special interest is the change in outlook on the emigration question, with the desire of the government to keep its growing population under its own flag, though Commendatore Villari does not mention the steady decline of the birth-rate, which defies all efforts to check it. No less valuable is the chapter on the new Syndicalism and the attempts to regulate the relations between Capital and Labour on more or less permanent lines. L. C. M.

THE ARAB'S PLACE IN THE SUN. By RICHARD COKE. *London: Thornton Butterworth* 1929. 9×6 *inches;* 318 *pages; map and illustrations.* 21*s*

In two earlier books Mr. Coke has shown his sympathetic understanding of the Arabs and a grasp of their history, with special reference to 'Iraq. The same qualities are here displayed in a wider survey of the history of the Arabs as a whole, from Spain and Morocco to the Perisan Gulf, from pre-Muhammadan times to the present day. One cannot but admire the skill and sureness of touch with which, more especially in the sketch of the career of Muhammad and the early Arab empire, the materials derived from a really remarkable range of reading are condensed into a plain and intelligible narrative. The chapters dealing with the later mediaeval period—an exceedingly difficult period to investigate—are open to rather more criticism on points of detail. The author, for example, underestimates the Arab element in the agricultural population of Egypt, and perhaps exaggerates the weakness and misrule of the Turks. But the

second and larger section of the book, in which the modern history and contemporary conditions of the Arab world are explained, makes ample amends. Though confessedly written from the point of view of an ardent sympathizer with the Arab cause and supporter of an Anglo-Arab entente, the tone is not partisan; the weaknesses of the Arabs and the arguments of their opponents are given due weight. It is just this outspokenness and realism that give the book its chief value. Mr. Coke's style is lucid and persuasive, and one's only regret is that the price of the book may stand in the way of its obtaining the large circulation which it deserves. H. A. R. G.

A BAGHDAD CHRONICLE. By REUBEN LEVY. *Cambridge: University Press* 1929. 9×6 *inches;* xii+279 *pages; illustrations.* 15*s*

The subject of Mr. Levy's book is neither the romantic Baghdad of the 'Arabian Nights,' nor the imperial city of Muslim dreams, but plain workaday Baghdad, the reality behind the romance and the imperial pomp, so far as the author can recover it by diligent study of the original sources. Something—a good deal, in fact—of the political vicissitudes of the city was bound to find a place, seeing that from its foundation in 762 until its capture by the Mongols in 1258 (the limits which Mr. Levy has set to his 'Chronicle') it was the seat of a dynasty that never lost its worldwide pretensions. But to those who wish to learn the human values behind the dry facts of the ordinary history book, this work may be confidently recommended. H. A. R. G.

THE RIM OF MYSTERY: A Hunter's Wanderings in Unknown Siberian Asia. By J. B. BURNHAM. *New York and London: G. P. Putnam's Sons* 1929. 9×6 *inches;* xvi+282 *pages; illustrations and sketch-map.* 15*s*

The 'Rim of Mystery' is described as a Hunter's Wanderings in Unknown Siberian Asia, and deals with the Chukotsk Peninsula, just inside the Arctic Circle and just opposite Alaska.

The book is admirably got up but suffers from the lack of an adequate map, making it very difficult to follow the author in his wanderings. Mr. Burnham does not write with the enthusiasm of the explorer. He was obviously interested in the Siberian Eskimo, but we should have liked to know more about the Chookli, whose primitiveness is proverbial. Possibly the author was disgusted with their grossness and lost any sympathy he ever had on discovering that they were treacherous and lazy.

Several chapters are devoted to the hunting of the peneak, a species of mountain sheep that inhabits the inland hills. It was a matter of difficulty rather than adventure to obtain a specimen. Eventually one was obtained: it is described as of "mouse colour with a black dorsal streak: in general like a caribou in the summer coat: while the shape of the horns reminds us of the old hartebeeste of Central Africa." H. P. W

MAP SHOWING DISTRIBUTION OF POPULATION IN THE JAPANESE EMPIRE. By TETSUJI ONO. Scale 1 : 1,500,000 (1 inch to 23·67 stat. miles). *Tokyo: Fuzambo* 1925. 56×40 *inches*

The problem afforded by the growth of the population of present-day Japan proper is, as all students of Far Eastern politics are aware, at the root of much of the controversial intercourse between Japan and her neighbours on both sides of the Pacific. To all such a work of the type of this latest map of the Japanese Empire would naturally be of the greatest interest and value were it not for the fact that it is engraved in character. It is a matter for much regret that the immense amount of patient research and painstaking labour in various fields which have gone to the production of this map should *ipso facto* fail of their just

reward in the eyes of many Western geographers and students of political affairs, to whom, as an important work, it should be of great usefulness.

The map shows the density of the population for each county (*gun*) in the Empire, the figures being based on the final official returns of the first census (1920). As, however, these statistics are not given in the official report, the necessary calculations were made by Mr. Ono himself. The figures are of considerable interest to those familiar with the geography of Japan, and in some case afford vivid illustration of the fact that at least three-quarters of the area of Japan proper is actually mountain land. In these regions, which are largely uncultivated because uncultivable, the sparseness of the population is very remarkable, in some cases falling as low as 16·4 per sq. kilometre, *e.g.* in the Minami-Aizu district of Fukushima Prefecture.

Even in the Kita-Kuwada district, which is only a few miles distant from Kyoto, the famous former capital, in a relatively thickly populated region, the density is as low as 35 per sq. kilometre. The density of population is represented for each county by one of the nine shades of colour (pink, brown, and green, in three shades each); while the range of population of the principal towns and cities is indicated by small circles of seven varying sizes.

For the credit of the compiler of this map and his colleagues, it should be stated that the work is one of private, and not Government, enterprise. It is the first of any kind to show the density of population for counties, and it represents much painstaking labour. The whole undertaking was carried out under the direction of Professor G. Ishibashi, head of the department of anthropo-geography in the Imperial University of Kyoto. The necessary funds were generously provided by Count Yanagisawa, of Tokyo. W. W

L'ALGERIE. By AUGUSTIN BERNARD (Bibliothèque d'Histoire Contemporaine). *Paris: Felix Alcan* 1929. 9×6 *inches;* xvi+522 *pages.* 45 *francs*

For nearly all of the French colonies there are available accounts by scholarly hands; not merely momentary records of their ever-changing life and possibilities, but solid accounts of their history, geographical conditions, and not least, or least sympathetically, of their indigenous occupants. Algeria has engaged the attention of many skilful writers, among whose works the volume now before us must take a leading place as one of the standard authorities on that country. The heading of its five "books" will indicate its scope and proportion: 'Les conditions géographiques' (80 pp.); 'L'Algérie jusqu'à la conquête française' (45 pp.); 'L'Algérie depuis 1830' (146 pp.); 'La démographie et l'organisation' (108 pp.); and 'La mise en valeur' (90 pp.).

To those who know Algeria, its original cost in lives and self-sacrifice and its marvellous recent progress, above all the reality of the bond established between colonist and *indigène*, it will not seem at all an exaggerated phrase to speak of 1930 as a " glorious centenary," nor an unjustifiable claim to say "Nous l'avons pacifié, outillé, organisé; nous avons rénové ses cultures anciennes, introduit des cultures nouvelles, mis en valeur les richesses de son sol et de son sous-sol, développé son commerce et son industrie. . . . Les indigènes pourront s'associer sans arrière-pensée à la commemoration d'une conquête qui leur a été somme toute bienfaisante, comme ils s'associent désormais à nous dans la mise en valeur du pays."

To those who do not know the fascination of the country and its people, or who (as we constantly find) are amazed at the number and distribution of its Phoenician, Roman and Christian remains, many yet to be investigated, or who want to get a real understanding of the influence and marvel of the Moslem wave of conquest, and, despite that, of the vigour and vitality of animistic beliefs, as

well as to those who are practically interested in the common problems of colonization, we heartily commend Algeria as a readily accessible and prolific source of suggestive information.

We hope that a similar work may be produced before long for the French Protectorate of Tunisia and for French Morocco, with especial attention to the much-needed study of tribal admixtures and intrusions. Much would be gained by the comparative method of treating the Barbary States as an integral unit, albeit with ever-varying inter-relations. There is a great opportunity for intensive study here, but also for comprehensiveness of outlook. Professor Bernard has admirably shown us the way in which the other two States should be studied. Maps and an index, however, both of which are lacking in the present work, should not be omitted from forthcoming volumes. WM. C. PIERCY.

GREENLAND. Published by the Commission for the Direction of the Geological and Geographical Investigations in Greenland. Edited by M. VAHL and others. Vol. II: The Past and Present Population of Greenland. *Copenhagen: C. A. Reitzel; London: Humphrey Milford,* 1928. 11×7 *inches;* 416 *pages; illustrations.* 35*s*

This is a most useful work, written by experts, on the past and present inhabitants of Greenland. The greater part of the volume, which is divided into six parts, is naturally about the Eskimo.

The first part, "Greenlanders of the Present Day," by Kaj Birket-Smith, occupies about half the volume. He gives a number of extremely interesting statistics concerning the Eskimo. Their present number is not much under 15,000, and it is pleasant to learn that, unlike most primitive people in contact with Europeans, they are increasing in number; there is a considerable surplus of women over men, due to the very high rate of mortality among men between twenty and thirty-five years old owing to the dangerous seal-hunting in kayaks. The economic life of the various groups of Eskimo is dealt with in detail under such heads as hunting from kayaks, seal and walrus hunting on the ice, hunting of sea-birds, and fishing; and their daily life is described. The making of kayaks and umiaks is fully explained. It is interesting to learn that the use of kayaks was introduced in the Thule district as late as the sixties of the last century by families who had migrated from Baffin Land; but at Washington Land the remains of an old kayak were found, showing that they had been in use there at an earlier period. The differences in culture between the various groups, Polar, Angmagssalik and the inhabitants of Western Greenland are described.

The second part, "The Intellectual Culture of the Greenlanders," is by Dr. C. W. Schultz-Lorentzen, who gives a brief description of the Greenlandic language, conception of the Universe, religious ideas, and art. It is interesting to note that the Angmagssalik seem to have developed a much more elaborate form of decoration than the other Greenlanders. A number of folk-tales are given to illustrate their unwritten literature.

In the third part Dr. Thomas Thomsen deals with "Eskimo Archæology." He points out that owing to the lack of scientific excavation there is still much work to be done before we can gain any adequate and definite knowledge of the prehistory of Greenland. The Eskimo had the habit of burying some of the possessions of the dead in their graves, and these would normally have been a most valuable aid in the establishment of a fairly accurate chronology, but unluckily they had also the habit of using the same grave again at a later period, and so confusing the associations of objects found therein. Dr. Thomsen describes the various dwelling-places at some length. It is of interest to learn that, whereas only the Polar Eskimo now use snow houses in winter, they were formerly used

much farther south, as snow-knives have been found on both coasts as far south as between 67° and 70° Lat. There is still some difference of opinion about the routes the Eskimo took on their arrival in Greenland. It is generally agreed that they arrived from across the narrow straits off the north-west coast; Birket-Smith and Knud Rasmussen hold that from thence they went south along the west coast and up the east coast, while Dr. Thomsen himself, Mathiassen, Thalbitzer, Schultz-Lorentzen and others think that part of the east coast was peopled from the north.

The last three parts, "On the Icelandic Colonization of Greenland" by Dr. Finnur Jonsson, "Old Norse Farms" by Captain Daniel Bruun, and "The Finds from Herjolfsnes" by Dr. Poul Nörlund, deal with the discovery and occupation of Greenland by the Icelanders. Dr. Jonsson gives a summary of what is known of the discovery and gradual colonization of the country at the end of the tenth century; the means of subsistence and the manner of life of the population are described; and an account is given of such history as is known of the colony until its overwhelming by the Skraelings—the Vestribygd having been first overcome by Eskimo coming from the north and later the Eystribygd, according to Thalbitzer, by others coming from the south; the date of the latter event cannot be placed earlier than the end of the fifteenth century. It was the submission of the Greenlanders to the rule of the Norwegians, in 1261, which proved their undoing; for in 1294 the whole of the Greenland trade became a monopoly, a Norwegian trading vessel making a voyage there once a year. The colony was entirely dependent on this vessel for supplies of grain, which it was impossible to grow in Greenland; but the ship was frequently lost and in some years did not sail at all; and in 1406 a vessel, driven by gales, seems to have arrived for the last time. It is easy to understand that the unfortunate white men, weakened by lack of suitable food, had no chance against the ever-increasing numbers of Eskimo enemies.

Captain Bruun gives an account of the character and use of the Icelandic farms in Greenland, with detailed descriptions of the remains of farmsteads which have been found in various parts of the settlement; and in the sixth and last part of the volume Dr. Nörlund, well known as part-author of Vol. LXVII of *Meddelelser om Grønland*, again describes some of the remarkable results of his excavations in the old Norse church and churchyard at Herjolfsnes.

The whole volume is excellently illustrated by many fine plates and by figures in the text. The map is unfortunately over-reduced, so that the names are almost unreadable. L. C. G. C.

WHEN FUR WAS KING. By HENRY JOHN MOBERLY, in collaboration with WILLIAM BLEASDELL CAMERON. *London and Toronto: J. M. Dent & Sons* 1929. 8×6 *inches;* xvi+238 *pages; illustrations and map.* 10*s* 6*d*

This very entertaining story of the early Canadian fur trade is, as Mr Cameron remarks in his introduction, a purely personal record. Henry John Moberly still lives at the age of ninety-four, and the book is chiefly an account of his former life in the North-West from 1854 to 1894. The peculiar importance of the narrative lies perhaps in its vivid presentation of the dramatic side of frontier life in the middle of the last century. The days of Red River carts, York boats and pack trains are linked in at least one living memory with the coming of the railway, the Cariboo gold rush, and the disappearance of the buffalo. Now, as the authors suggest in conclusion, " we have the Hudson Bay Railway starting at the Pas and nearing completion on the shore of that great inland sea. Is it too wild a stretch of the imagination to envision a time in the not-distant future when a second Hudson Bay Railway will span the Barren Ground between Lake

Athabasca and Fort Churchill, . . . carrying frozen reindeer carcasses and fish from the inexhaustible stores in the lakes of the interior to the markets of the East and of Europe?"

Mr. Moberly, who was born in 1835 in Barrie, Ontario, at the age of sixteen secured a position with Lloyds at St. Petersburg. But the novelty of Russian life palled, and he returned to Canada, where Sir George Simpson, then Governor of the Hudson's Bay Company, gave him a position with that organization. During forty years of service he was principally engaged in the fur trade around the neighbourhood of Edmonton, with excursions into the regions of the Frazer Lake in British Columbia, the Peace River country, and the territory north of the Saskatchewan. There are chapters of travel between trading posts and explorations beyond into the wild Athabasca, descriptions of routine life at the posts in " the 'fifties " and the methods of conducting the Indian trade, particularly with Blackfeet and Crees.

As an autobiography the book is a romantic but nevertheless highly valuable addition to our knowledge of the conduct of the fur trade in the later days of Hudson's Bay Company control. As a dramatic presentation of early frontier life in Canada, it is no small contribution to Canadian literature. G. S. G.

THE SOUTHERN FRONTIER, 1670–1732. By VERNER W. CRANE. *Durham, North Carolina: Duke University Press* 1928. 9×6 *inches;* xii+390 *pages; frontispiece and map.* 20*s* 6*d*

The standard accounts of the Anglo-French rivalry in North America will need revision as the results of Mr. Crane's research are assimilated. Hitherto attention has been concentrated on the Canadian frontier and on the struggle for the Ohio, in which the Virginians were the protagonists on the British side. The present work shows that the Southern Frontier was a debatable area from the end of the seventeenth century, and that the handful of colonists in South Carolina were engaged in far-reaching schemes which brought them into contact with the French on the Mississippi as soon as ever the French were established there. The unofficial struggle had begun in the South before the Ohio had come within the range of Anglo-French ambitions; and, what is more, the home governments were aware of the situation and were early framing policies of domination.

It may seem strange that these important matters have hitherto received so little attention. The explanation, it may be suggested, lies in a predilection and in a false assumption. Investigators of the formative period of the old colonies have been attracted by their social or political institutions or by their relations with the imperial government. We have exhaustive accounts of constitutions—and those of the proprietary colonies are especially tempting—and of the stock antithesis between the local rights of Englishmen and the supremacy of Parliament. Trade has not been neglected, but under the influence of the late G. L. Beer it has been the inter-imperial sea-borne trade that has been chiefly studied. It has been tacitly agreed that the continental trade of early North America was comparatively unimportant: commerce which had no Navigation Acts to infringe has not attracted the historian. So much for the predilection. The unwarranted assumption has been suggested by the map. An enormous area separates the Carolina coast from the Mississippi. As late as 1719 South Carolina contained only 9000 white men. Obviously Charleston had little opportunity for conflict with New Orleans. Obvious as it seemed, it was not the truth, as Mr. Crane very clearly demonstrates.

His first two chapters concern the foundation of the province and its frontier troubles with Spanish Florida. These latter are fully set forth, but they are not

the main business of the book. That begins with the chapter on "The Mississippi Question," whose opening date is 1697. The following 280 pages tell the story of the extraordinarily rapid and far-flung expansion of the trading pioneers thrown forward by the little southern colony, of their wide system of alliances and protectorates over the inland tribes, of their conscious thinking-out of big schemes and partial success in realizing them, and of their continuous rivalry with like-minded Frenchmen, with the Spaniards taking part as a less important third party. The frontiersmen of Carolina here stand forth as the worthy counterpart of the *coureurs des bois* of New France. The account ends with the genesis of Georgia which, in conception, grew out of the frontier conflict and antedated the philanthropic plans of Oglethorpe.

The book is well planned and lucidly written. That it is somewhat tough reading is not altogether the fault of its author. He has to deal with a multitude of persons and places unfamiliar to the ordinary student, and few things tire the attention so much as the names of Indian tribes and their habitations. Perhaps a little more emphasis in their introduction might occasionally have been employed with advantage. Mr. Crane has made a contribution of outstanding importance to colonial history. It may leave some of us a little rueful at the imperfection it reveals in our textbooks. But of the revision of history there is no end.

J. A. W.

TO FAR WESTERN ALASKA FOR BIG GAME. By T. R. HUBBACK. *London: Rowland Ward* 1929. 9×6 *inches;* xiv+232 *pages; illustrations and map.* 15*s*

Mr. Hubback describes two hunting trips to Alaska, the first in the Kenai peninsula and the Skwentna and Hayes valleys, the second into the western end of the Alaskan peninsula. These are little-known regions seldom visited, and Mr. Hubback was able to get several fine specimens of giant moose, white sheep, brown bears, and woodland caribou. His enthusiasm brought him on both occasions from his home in Malaya to Alaska, and has induced him to write a spirited account of his hunting adventures, with many useful hints to those who may follow in his tracks. Even those who find little excitement in the chase will find this book of interest, for Mr. Hubback's enjoyment is reflected in his pages. There is also much of value about these comparatively rare animals. Mr. Hubback hopes that the United States will, before it is too late, make a reserve for the Alaskan brown bear and Grant caribou in the extreme south-west of the Alaskan peninsula. The book is well illustrated and has an excellent large-scale map of the whole of Alaska—an example to many publishers of travel books.

R. N. R. B.

INDUSTRIAL AND COMMERCIAL SOUTH AMERICA. New and revised edition, by ANNIE S. PECK. *New York: Thomas Y. Crowell Company* 1927. 8×5 *inches;* xvii+489 *pages; and maps.* $3.50

Geographical works on South America tend to fall into either the purely descriptive or the interpretive-descriptive class. In the former we have a number of recent books written by American authors, who aim first and foremost at supplying information that will be of interest and value to the growing section of the business community in the United States which has trade relations with the southern continent. These books are usually heavily loaded with statistics and other detailed material, the interpretation of which is left mainly to the reader. The authors are not greatly concerned with selection of the material relevant to the presentation of any particular picture or argument. With them the main purpose is to collect reliable facts, expressed numerically wherever possible, and to tabulate them as intelligibly and as concisely as may be.

Miss Peck's book is distinctly of the descriptive and informative class. In this revised edition she has expanded the material of the original work, and has brought the statistical information as nearly as possible up-to-date. The latter has been no light task in view of the way in which figures of one kind or another appear in almost every paragraph. As to the general plan and the detailed arrangement, the author has followed the simple and obvious method of dealing with each of the countries in turn, devoting a series of chapters to each. These treat in order of the country as a whole, of its physical characteristics, of its administrative subdivisions, of its means of transportation, and of its resources and industries. It is thus an easy matter, simply by consulting the general index of contents, to know where to look for any desired item of information. In addition to the forty-nine chapters in which the countries are covered in detail, there are three general chapters on the Continent, and five appendices, in which certain miscellaneous information of special value to travellers and traders has been collected.

Owing to the systematic cataloguing of facts, which runs from the first page to the last, the book has to be taken in small doses if one wishes to retain anything definite from this kaleidoscopic display of material. In intention, however, it is clearly designed as a handbook for the use of business men in America and of their envoys to South America, who will presumably be interested in only one section of the continent at a time. The book is a mine of information drawn largely from official and semi-official reports, and so far as this information is statistical, its reliability obviously varies with that of the sources from which it is derived. These are not always absolutely unquestionable for inter-census data, nor even for census data in some countries in South America. The maps supplied are of the simplified railway type showing a minimum of relief. Some of them, notably that of Peru, are on too small a scale to show more than a selection of the places mentioned in the text. E. W. S.

GEOLOGIE VON PERÚ. By G. STEINMANN. *Heidelberg: Carl Winters Universitätsbuchhandlung* 1929. 9×6 *inches;* xii+448 *pages; illustrations and a geological map. In paper covers* 28 *marks; bound* 32 *marks*

Steinmann's book is a thoroughly documented summary of the present state of knowledge concerning the geology of a peculiarly interesting country. A glance at the map supplied with the work shows what a small proportion of Peru has been surveyed at all; how much of the detailed geology of the areas that have been traversed still remains to be worked out, becomes abundantly clear from the text. The districts which have naturally received most attention are the mineralized sections of the Cordilleran region together with parts of the coastal strip, among the latter especially the north-western petroliferous area. The fact of the matter is that the geologist has a peculiarly difficult task in most of the inhabited regions of Peru owing to the complications introduced by intense folding and faulting and by widespread intrusions of igneous rocks.

More than half of this book is devoted to a detailed description of the stratification in the areas studied. This technical matter will be of interest mainly to the expert geologist. The later sections of the work, which are of a more general nature, will appeal to a much wider public. In that entitled "Geological History" we have a summary account of the vicissitudes through which the Peruvian region has passed throughout geological time. We gather, for example, that the continent at one time extended much farther west than at present, and that the oceanic troughs off the coast are of recent formation. Next follows a short but graphic section on the general build of the Andes. Finally there are two sections which have been contributed by other authors, one on useful

minerals by R. Stappenbeck, and one on earthquakes in Peru by A. Sieberg. Of these the former is definitely an essay in the economic geology of the country, which indicates the position, the nature and, wherever possible, the extent, of the known deposits of the minerals; while the latter constitutes an attempt to relate the frequent crustal disturbances to the seats of their origin.

Altogether this work forms an instructive record of the author's researches correlated with the work done by predecessors and contemporaries. It will be valuable both as an epitome of knowledge to date and as a model of careful workmanship for the Peruvian geologists who are actively conducting research in their wonderful field. E. W. S.

THE TASMANIAN ENVIRONMENT: A Human and Economic Geography of Tasmania. By GORDON L. WOOD. *Melbourne: Robertson & Mullens* 1929. 8×5 *inches; 107 pages; maps and diagrams.* 3*s*

A careful reading of this book, now in its second edition, gives a clear picture of the causal connection between geographical factors and the various phases of economic life in Tasmania. It is simple in treatment, yet sufficiently detailed. No important topic appears to be omitted, but there is little that is superfluous. The author is fortunate in having a small and fairly compact area to deal with, which at the same time presents a considerable variety of structure, of climate and occupations. He has thus had opportunities of using his material to illustrate the operation of a number of fundamental principles in economic geography.

On the other hand, this book is in no sense a pioneer work. No new principles are advanced, and there is no discussion of problems. It is primarily a text-book, with the merits and defects of works of that class; but it will serve also as a condensed and well-informed handbook of information on the geography of the island, especially its economic geography, for those who do not know it at first hand. Among the different topics handled, the inter-relation between geological structure and economic life is well done, while the great pastoral industry appears to get less than its fair share of space and elucidation. Some of the maps in the text suffer from over-reduction, so that the lettering on them is difficult to read. E. W. S.

NOTES AND SKETCHES MADE DURING TWO YEARS ON THE "DISCOVERY" EXPEDITION, 1925–27. By E. R. GUNTHER. Reprinted from the *Draconian* for 1928. *Oxford: Holywell Press* 1928. 52 *pages; illustrations and maps*

On his return from a two-years' cruise in the South Atlantic Ocean in the R.R.S. *Discovery*, Mr. Gunther wrote in diary form this account of his experiences for the magazine of the Dragon School, Oxford. It lays no claim to be anything more than a popular narrative, but it contains much interesting information on the methods and work of the whaling research on which the *Discovery* was engaged, and it is full of notes on natural history. There are moreover many glimpses of out-of-the-way places, such as South Georgia, Gough Island, Tristan da Cunha, and Bouvet Island. And there are many good photographs and sketches by the author, including one of the elusive Shag Rocks and another of Bouvet Island. It is a delightful pamphlet, and gives a far better account of the work of the expedition and incidentally of the failings of the *Discovery* as a ship, than the terse accounts in the two annual reports which have so far appeared, though Mr. A. C. Hardy's paper in the *Journal* for April 1928 must not be forgotten. We hope that Mr. Gunther will give us more in the same vein and in a form accessible to a wider public. R. N. R. B.

THE GEOGRAPHY OF THE POLAR REGIONS : consisting of a General Characterization of Polar Nature, by OTTO NORDENSKJÖLD ; and a Regional Geography of the Arctic and Antarctic, by LUDWIG MECKING. (Special Publication No. 8.) *New York: American Geographical Society* 1928. vi+360 *pages; illustrations and maps.* $4

The American Geographical Society has done a service to all students of Polar regions in the publication of this and its companion volume, 'Problems of Polar Research' (see *Journal*, July 1928). The present volume is not however a new work, but a translation of two books that were not previously available in English. Dr. Nordenskjöld's 'Polarnaturen,' which forms the first part of the book, first appeared in Swedish in 1918. It was the outcome of a course of lectures originally delivered in 1916, but revised ten years later. It is in the revised form that it now appears. There are six short chapters dealing respectively with climate, ice, causes of the Ice Age, soils and land forms, vegetation and animal life, and the delimitation of Polar regions. The whole forms an admirable introduction to Polar problems even if the reader experiences disappointment that so well-qualified an author does not discuss at greater length some of the problems which he propounds. Dr. Nordenskjöld can find no satisfactory explanation for the occurrence of many ice-free areas in Arctic regions. He gives full weight to such causes as high summer temperatures and lack of precipitation, but maintains that they cannot afford the explanation in Spitsbergen, where ice-free and ice-covered regions adjoin, or in the higher mountains of Western Greenland. Greater or less porosity of the rocks may have some influence, and topography certainly plays a part, but the full explanation is not yet forthcoming. The chapter on the Ice Age is a valuable discussion of a difficult problem. Soils and land forms receive little notice, but some attention is given to solifluction and polygonal soils. The difficult problem of air circulation in Polar regions is touched on, but Dr. Nordenskjöld has been too wise to offer a full explanation. He devotes some attention to the delimitation of natural provinces within Polar regions. In the Polar regions proper he finds two provinces of which the high Polar belt covers most of the Arctic regions and is represented in the Antarctic only on a few islands. The Antarctic belt, on the other hand, is found in the Arctic only on the highlands of Greenland. A third or outer Polar belt covers the continental rim surrounding the Arctic sea and a few islands in the Southern Ocean. These belts are defined in terms of temperatures of the warmest months.

The second part of the volume is a translation of Dr. L. Mecking's 'Die Polarländen' (1923). It is an ambitious and fairly successful attempt to provide a regional geography of Polar region. For both Arctic and Antarctic several general chapters are followed by detailed accounts of various regions. Arctic Asia, Canada, and Europe and the islands of the Southern Ocean are included in the survey. The work contains a great wealth of facts collected from many scattered sources and should prove valuable for reference purposes. There are useful bibliographies of recent works classified under the lands to which they refer. The photographs and maps are numerous and well reproduced, and a word of praise is due to the excellence of the translators' work. R. N. R. B.

THE VOYAGES AND TRAVELS OF CAPTAIN NATHANIEL URING: With introduction and notes by Capt. ALFRED DEWAR, R.N. (The Seafarers' Library.) *London: Cassell & Co.* 1928. 9×6 *inches;* xxxiv+254 *pages; illustrations.* 10*s* 6*d*

The reading public of the early eighteenth century had an insatiable appetite for tales of sea adventure. The course of events changed the nature of the fare, but

an abundant supply was always forthcoming. The end of the Spanish war of 1718, and the close of the period of Atlantic piracy, to which the survivors of the buccaneers had turned after the Peace of Utrecht, left the field open for a new departure, and publishers began to seek their advantage in detailed accounts of trading voyages. The first of these appeared in 1726, a year otherwise marked by the publication of Shelvocke's voyage, the last of the privateering voyages of circumnavigation, and, incidentally, by the completion of Gulliver's Travels, a work long on the stocks. Two books in the new fashion appeared in this year, each of them by a merchant captain describing the voyages made by him over a considerable period, the 'Four Years' Voyages' of George Roberts, and the 'Voyages and Travels' of Nathaniel Uring.

Until recently the merchant seaman, as such, was an obscure person, of whom, generally speaking, the public could know nothing; and so far did this obscurity go that his very existence might be doubted, and his plain tale be regarded as a work of fiction. Thus, because nothing more is at present known of Roberts than he himself told, and because at the time when he wrote Defoe was producing maritime fiction, it has been suggested, almost certainly wrongly, that 'George Roberts' was but another pseudonym of Daniel Defoe. There is no apparent reason why the same doubt should not have been expressed about the identity of Nathaniel Uring had he stood by his 'Voyages' alone; but, fortunately, when his voyaging was over he was appointed deputy-governor of Santa Lucia, and this appointment, though rendered abortive by a rival French claim backed by *force majeure*, served at least to establish him as an historical personage. Captain Dewar, in his careful and interesting introduction to the present reprint, has brought together all that need be known of Uring and his family, and has shown that his hard life at sea did not go unrewarded. By capture and shipwreck he was on various occasions stripped bare, but he ended worth some thousands of pounds.

Uring went to sea in 1697 at the age of fifteen, and within two years his experiences included two coasting trips, a voyage intended for the West Indies, on which his ship was taken by a French privateer, a voyage to Malaga for fruit, and another to Barbados, Newfoundland and Virginia, in the course of which he only narrowly escaped when his ship was burnt, and afterwards nearly died of smallpox. He then joined the Navy, and in 1700 was in the fleet under Rooke which went to the Baltic. In the next year he was mate of a Guinea-man, and, returning home just after the outbreak of war, was nearly captured by the French, and, on reaching Spithead, was promptly pressed into the Navy. He served as midshipman in the expedition to Cadiz and Vigo, and was then discharged that he might enter the post-office packet service. He continued in this, at first as master, afterwards as captain, for ten voyages to the West Indies, during which he was many times chased by the enemy and was at last captured and carried as a prisoner to France. On his next voyage, to Boston and the West Indies, he was again captured by French privateers, but was allowed to ransom the ship. After a further experience of the Guinea coast, he went to Jamaica, and thence engaged in the illicit trade with the Spanish main. Then came an adventure to the Honduras coast for logwood, which resulted in shipwreck and extreme hardship; but neither the almost unknown pilotage of the coasts of Yucatan, nor the mosquitoes and sandflies "which made our men grow so impatient that they raved, stormed, and swore like Bedlamites," nor his privations among the "marooners" and Indians, daunted him. He had learnt enough of the coast and of the logwood trade to wish to return to it, which later he did, at the cost of further shipwreck but ultimate gain. Compared with these experiences the voyages which he made after the Peace of Utrecht to the Mediterranean and to America were almost

pleasure sailing. He left the sea in 1721, after twenty-four years' service, went fruitlessly to Santa Lucia in 1722, and thereafter lived quietly in England, where he died twenty years later at the age of sixty.

It is not very easy to make a picture of the man. That he was mentally alert, a good observer, and an able recorder his narrative shows. The incidents of his career reveal him as a man of enterprise and determination, one to whom all the perils of the sea in war and peace came but as part of the day's work. We do not learn, however, in what light he appeared to his crews, though it may be suspected that he had a character for hardness. On one occasion he speaks of his men as "baptized beasts,"—a happy phrase, no doubt, but hardly sympathetic,—and again describes the drawing up of a round robin and an incipient mutiny, which he quelled by prompt violence; and he mentions difficulties and misunderstandings with his officers. On the whole he was probably doubly fortunate in never having fallen into the hands of the pirates who infested the seas in which he sailed; for the black-flag men of that generation had a pleasant way of dealing with the officers of captured ships according to the account which their crews gave of them. L. G. C. L.

CAPTAIN MATTHEW FLINDERS: his Voyages, Discoveries and Fortunes. By JOSEPH BRYANT. With a Foreward by Sir FLINDERS PETRIE. *London: The Epworth Press (J. Alfred Sharp)*, 1928. 8×5 *inches; 194 pages; with portrait, 3s 6d*

This is a little popular account of the " voyages, discoveries, and fortunes" of Flinders, based on the recent important Life by Professor Ernest Scott. As Mr. Bryant has succeeded in giving an adequate account of the very important work done by Flinders in the discovery and survey of the coasts of the greater part of Australia, while showing, and even emphasizing, the highly adventurous nature of most of his voyages, his book is likely to prove interesting to a large circle of readers. He handles the difficult episode of Flinders's imprisonment at Mauritius with restraint and fairness, letting it be seen that there was after all something to be said on Decaen's side of the question, though this aspect of the case did not commend itself to the prisoner. It does not seem to have been noticed that a thing which may have had some effect in predisposing the governor to a hostile attitude was that his relations with the naval officers of his own country had been decidedly unfortunate. Before he was appointed to the Indian command he had fallen foul of the naval authorities at Toulon, and had formed the opinion that naval officers were arrogant in their dealings with officers of the army ; and it would seem that the conduct of Linois, who took him out to the East, must have confirmed this impression. It is very probable, therefore, that Flinders's virtuous indignation at finding himself suspected may have been put down to an entirely erroneous cause, and have rendered Decaen incapable from the outset of seeing the situation from the explorer's point of view. Whatever the cause, the mistake was most unfortunate, both to the service of hydrography and to the victim.

There are in the book minor blemishes which show that Mr. Bryant is not well acquainted with the general course of naval history, nor with the technical language in which it should be related, such as the persistent use of "on" for "on board" or "in" a ship, and the styling of a frigate a "gunboat." Drake did not, as Mr. Bryant seems to suppose, "singe the King of Spain's beard" on the Pacific coast of America; and the delay of Flinders's promotion, though undoubtedly a hardship, was one which he shared with even more distinguished men—with the celebrated Cochrane, for instance. L. G. C. L.

A VOYAGE TO SURAT IN THE YEAR 1689. By J. OVINGTON. Edited by H. G. RAWLINSON. *Oxford: University Press.* 1929. 8×5 *inches;* xx+314 *pages; illustrations and sketch-maps.* 12*s* 6*d*

This handy and well-produced edition of a work which has not before been reprinted is very welcome. It is true that the reverend author's experiences of India itself were limited to about three months at Bombay and two years and a half at Surat, where he was stationed as chaplain to the English factory; but he gives us a lively and very readable account, interspersed with anecdotes, of life at both places, including many details not to be found elsewhere. He also narrates fully the voyages out and home, describing Madeira, the Comoros, Ascension, and the Dutch settlement at the Cape; and he adds, from hearsay, chapters on Muscat and Mocha. The original edition includes a history of the "late revolution in the kingdom of Golconda," descriptions of Arakan and Pegu, and "observations concerning the silkworms"; but these, as having no bearing on Ovington's narrative, have been omitted in the reprint.

In his introduction, as the result of careful research, Professor Rawlinson provides an interesting biography of his author, concerning whom practically nothing was previously known; while to the narrative itself he has appended a number of useful notes. Some of these, however, are open to correction. The "Limpo" of p. 181 is surely not a place in Shansi province, but the seaport usually termed Ningpo (which Alexander Hamilton calls "Limpoa"). "Balsera" (p. 204) is not Bulsar (in Gujarat), but Basra, at the head of the Persian Gulf; the destructive plague there in 1690, to which Ovington refers, is a well-known event. "Santone" (p. 210) is a word of European, not Asiatic, origin, if the Oxford English Dictionary is to be believed; and the standard pagoda of Madras was a gold, not a silver, coin (p. 121). Some passages in the text seem to have called in vain for annotation, as, for example, the reference on p. 97 to "the present Queen Dowager." This was, of course, Catherine of Braganza, the widow of Charles II, and it is interesting to learn from Ovington that she took a lively interest in Bombay, which had formed part of her dowry.

The index is strangely defective, for we fail to find therein such important names as Aurangzeb, Sir John Child, President Harris, and Sir John Wyburn, to say nothing of some persons of lesser note. Most serious of all, however, is the failure to reproduce Ovington's two views of Bombay Fort in 1668, though reference is twice made to them. Presumably the two Dutch engravings of the same subject are intended to be a sufficient substitute, but with this we can by no means agree. One of those engravings, by the way, is labelled "*circa* 1720;" whereas they both appeared originally in Baldaeus's 'Naauwkeurige Beschryvinge van Malabar en Choromandel,' published at Amsterdam in 1672. W. F.

MANSON'S TROPICAL DISEASES: A Manual of the Diseases of Warm Climates. PHILIP H. MANSON-BAHR. Ninth Edition, revised. *London: Cassell & Co.* 1929. 9×6 *inches;* xx+922 *pages; illustrations and maps.* 31*s* 6*d*

This revised ninth edition of a work originally published in 1898, supplies an exhaustive and very finished Manual of the Diseases of Warm Climates. Those who, like the reviewer, can recall the first edition, cannot but marvel at the record of discovery and research here described. Of its 900 pages few indeed could have been written—because nearly all was unknown—a quarter of a century ago. While indispensable to the professional student of tropical disease, the volume contains much to make it a valuable companion to any educated traveller who ventures on unfrequented ways in the tropics. The illustrations—especially the 35 coloured plates—are excellent, and the text is written so clearly that no specialized medical training is required for the understanding of the

more salient parts. There are diseases briefly sketched here which are unknown, except by name, to the majority of the medical profession. The Appendix, which occupies a quarter of the book, is zoological and should be valuable to the pure scientist as well as to the medical man. Without doubt the volume is an important contribution to the branch of medical science with which it deals. It can be recommended alike to the Physician, Zoologist, and Traveller.

E. W. G. M.

THE GOLDEN ADVENTURES OF BALBOA, DISCOVERER OF THE PACIFIC. By ARTHUR STRAWN. *London: John Lane* 1929. 8×6 *inches;* 340 *pages; illustrations and map.* 12*s* 6*d*

This is an interesting addition to the "Golden Hind" Series, which includes Drake, Raleigh, and Frobisher, but not so far Columbus. There is not a great deal of literature concerning Balboa which is accessible to the general reader, and Mr. Strawn's volume is interesting and brightly written. It is a story which centres of course round the great march across the Isthmus of Panama to the Pacific, but we get some familiar glimpses of the man who was to develop from a reckless adventurer into an excellent general and an able administrator, and who was endowed with qualities, rare in those days, of mature judgment and foresight. The cause of colonial expansion and settlement suffered a severe blow when Balboa, the victim of what was little better than judicial murder, suffered in the market-place of Acla in 1519, aged only forty-four.

A good map should have been supplied, and the provenance of the illustrations, some of which have not reproduced well, should have been given.

M. L.

A LINK WITH MAGELLAN. Being a Chart of the East Indies, *c.* 1522, in the Possession of BOIES PENROSE. N.P. *Privately printed* 1929. 15×12 *inches;* [24] *pages, and facsimile*

It is to be wished that private owners of rare maps would oftener follow Mr. Penrose's excellent example by bringing out reproductions for the benefit of students. The present specimen appears to be but a portion of a larger original, and may not perhaps be of the first importance, but it has a special interest as probably one of the earliest charts to present the results of Magellan's voyage through the Malay Archipelago. It is reproduced in excellent style, in the original colours, and our thanks are due to the owner for sending us one of the 150 copies to which the edition is limited.

The letterpress briefly describes the circumstances of Magellan's voyage, and reprints Eden's translation of the relative passage of Peter Martyr. The owner regards the chart as possibly made by a companion of Magellan, but this may be questioned. He seems incorrect, for example, in holding that it was of Spanish origin. There is a line of Spanish on the back, but this has no reference to the map, and may have been already there when the draughtsman acquired the parchment. And (*pace* Mr. Penrose) the words on the maps recording Magellan's death, particularly the spelling of the name "Lho Magalhaẽs" (misread Magalhñes) seem certainly Portuguese, as is also the form of the definite article, where present (*a* China, etc.). The name Papua, if not necessarily a proof of later date, is another indication of a Portuguese source, while the inscription below has Padram (not Padrón), though this is possibly a later addition.

No attempt is made to compare the chart with others of its time, though some interesting points might so be brought out. The chart may perhaps belong to the group of once-existing Portuguese documents regarded by Mr. Abendanon (*Journal*, 54, p. 352) as lost links in the development of that nation's cartography

of this part of the world. He showed that the details given in the French maps of the Desceliers school must have been derived from such lost originals. And if we compare Mr. Penrose's chart with the Desceliers maps of 1546 and 1550 we find such a striking resemblance as to prove some direct or indirect connection between them. One or two puzzles remain, however. The special resemblance is to the *later* Desceliers maps, and this might suggest that the date of Mr. Penrose's chart may not be quite so early as he supposes. On the other hand, the very slight indication of Celebes (shown much more completely in the later Desceliers maps, though omitted from Spanish maps like Juan Vespucci's, Ribero's, and Cabot's of 1524, 1529, and 1544 respectively) might argue a comparatively early date.

A list of the place-names is printed, with identifications, but some of the readings adopted do not seem quite correct. The name for the Liu-Kiu group (which Mr. Penrose does not identify as such) is read as "xxx de Leequea," but it looks more like "Os Leequeia" (the "Lequios" of later maps). "Abarochina" should no doubt be Abatochina (as on the Desceliers maps), the name then given either to Jilolo or a small island east of it. And a slight mistake is made in reading the perfectly distinct "Arçipelago de S. Lazaro," Magellan's name for the Philippines. E. H.

GEOGRAPHY OF THE WORLD. O. J. R. HOWARTH and W. A. BRIDEWELL. *Oxford: Clarendon Press* 1929. 8×5 *inches;* 526 *pages; illustrations, diagrams and maps.* 6*s* (*In parts: Continents and Countries* 4*s* 6*d; The Earth and its Surface,* 2*s*)

THE WORLD: A General Geography. L. D. STAMP. *London: Longmans, Green & Co.* 1929. [English Edition.] 8×5 *inches;* viii+676 *pages; illustrations, diagrams and maps.* 5*s*

To compress the geography of the world into a school book of one volume is a difficult task if the result is to be readable and interesting. It entails careful selection and rejection of material and considerable power of lucid exposition. Both these books are fairly successful. We do not propose to compare them. Messrs. Howarth and Bridewell have contrived to include a great deal of matter in a relatively small compass. Their book is well proportioned and packed with valuable information set forth in an attractive manner. The second and smaller part of their book deals with physical geography and natural regions. The maps are clear and adequate. There are no pictorial illustrations. Exercises are given.

Dr. Stamp's book is an English edition of a volume that has had a wide use in Indian schools. After a section on physical geography, the treatment is regional. Maps and diagrams are numerous and there are some pictures and numerous exercises. Ten coloured maps are bound into the book. A few statements need revision; for example, that Iceland belongs to Denmark; that the Arctic Ocean is very shallow; that the cold desert climate occurs inside the polar circles, with the obvious implication that the circles are climatic boundaries; and the indication that Sheffield is an iron town. On the other hand, the use of actual temperature maps is welcome. The book is certainly a marvel of cheapness. R. N. R. B.

THE NEW BRITISH EMPIRE. By L. HADEN GUEST. *London: John Murray* 1929. 8×5 *inches;* 334 *pages; illustrations.* 7*s* 6*d*

In this book the author records his observations and impressions during visits to Canada, Australia, and South Africa. He is interested in the present and future conditions of these Dominions, their nationalism, resources, trade and especially the life of the settlers on the land. Time available necessarily

restricted the scope of his observations, but he is able to give interesting glimpses of the settler's life, his difficulties and opportunties, *e.g.* in the Peace River country. It all leads up to the question of migration, the importance of which has profoundly impressed Dr. Guest, and which he discusses at some length. The difficulties are only too obvious, and the author has been made well aware of them. The most hopeful experiment has been the sending out of boys, but the question naturally arises whether we are not thereby taking from the country much valuable potential energy. Co-operation of the Home Country and the Dominions is necessary if any satisfactory solution of the problem is to be found. Some Imperial body is necessary which can arrange the preparation, direction, and assistance that are requisite if any large and continuous scheme of emigration is to be successful. In the author's opinion we want a new emigration policy. We must insist on the migration problem being treated as one of the foundation conditions of a general Imperial policy embracing all parts of the Empire. Dr. Guest's conclusion is that "what is needed is an Empire Development and Migration Commission on the lines of that already formed and working in Australia, to pass in review all the resources of the Empire, and advise the Empire Governments as to how best these resources should be used, and how best population should be distributed." A co-ordinating information agency should be set up and should be directed by one man. It is certainly a suggestion which may well receive consideration at the next Imperial Conference.

E. A. P.

AN INTRODUCTION TO THE STUDY OF BIRD BEHAVIOUR. By H. ELIOT HOWARD. *Cambridge: University Press* 1929. 13 × 11 *inches;* xii + 136 *pages.* 42*s*

We have here a discussion of bird behaviour by an observer of the first rank, and, as is customary in Mr. Howard's volumes, it is provided with splendid illustrations. The author concentrates on two birds, the Reed-Bunting and the Yellow-Bunting, which he subjects to the closest examination. He records every detail of behaviour, the disintegration of the winter flock, the establishment of the spring territory, the love-song, the pugnacity, and the courtship antics associated with the nesting period. The book is a model of careful study in the intimate details of a bird's life. But the author does not stop there. Basing his arguments on the facts secured so laboriously, he endeavours to enter into the bird's mind and to analyze the nature of its varying behaviour. Here we enter the field of speculation, the thorny subject of animal psychology, where there will necessarily be disagreement and doubt. It is far too big a problem to discuss here, but the author's treatment is both stimulating and original, and his book should prove an incentive to those who strive to understand the behaviour of birds.

R. W. G. H.

THE MONTHLY RECORD

THAMES TIDAL FLOODS INVESTIGATION

In pursuance of recommendations (*G.J.*, 72, p. 184) made during an inquiry conducted soon after the disastrous London flood at the beginning of 1928, the Liverpool Tidal Institute together with the Meteorological Office undertook to investigate the whole question of abnormal tides in the estuary of the Thames. The result of the research now appears as *Geophysical Memoir* No. 47 of the Meteorological Office. This memoir is divided into two parts, the first being a "Report on Thames Floods," by Dr. A. T. Doodson, of the Liverpool Tidal Institute, and the second "Meteorological Conditions associated with High Tides in the Thames," by Mr. J. S. Dines, of the Meteorological Office. From a study of the frequency curves Dr. Doodson concludes that a dangerous flood is liable to occur only once in sixty years, whilst Mr. Dines finds that, though it would be possible to issue forecasts of the likelihood of certain tides exceeding the calculated tide by a specified margin, it is not practicable at present to issue useful forecasts of *dangerous* tides. The reason is that for some unexplained cause the greatest anomalies in the height of the tide due to meteorological causes, such as a stiff north-westerly gale in the North Sea, tend to occur at half tides rather than at full tides. This is, of course, a fortunate dispensation, but it means that a good many false alarms would be raised were warnings given in the present state of knowledge.

THE *MURGE* OF APULIA

The term *Murge*, though not to be found in an ordinary Italian dictionary, is in fairly wide use in Southern Italy for lines of hills and surface undulations which do not rise to the height of mountains but are distinctly differentiated from lowland plains. Those which occupy a large part of Central and Southern Apulia are vividly described in *Le Vie d'Italia* for June 1929, by Sig. C. Colamonico, who, after explaining their physical characters, discusses the effect which these have had on the human life of the region, and the remarkable way in which the natural disadvantages are now being overcome. Apulia differs from most of the provinces of Italy in the almost entire absence of mountains, the generally arid surface of its southern half rarely rising more than 200 m. above sea-level. Its *Murge* constitute a calcareous upland, quadrilateral in form, falling to the neighbouring seas and lowlands in a series of steps or terraces, bearing witness to pauses in the slow process of elevation to which the region was subjected in the past. These steps vary in steepness, and it is where they are most pronounced that the term *Murge* is most in evidence. As in other limestone regions, the surface is bare, rocky, and arid, fertile alluvium being found only in the depressions into which it has been washed. The higher zone hardly possesses a single centre of human habitation, an area of more than 1300 sq. km. being practically uninhabited, and contrasting strongly with the neighbouring lowlands where the density rises to 400 per sq. km. The tendency seen throughout Southern Italy towards concentration in certain centres (due in part to the former liability to raids of corsairs and brigands) has been particularly marked in this region, which can show only 110 inhabited centres as compared with 2000 in an equal area in certain provinces of Northern Italy. But in recent years a great transformation has begun. A movement has been set on foot from the towns to the surrounding country and large formerly uninhabited areas have been brought under cultivation, the vine, almond, and olive having been planted extensively, as trees are better able to withstand the summer drought than other crops. Every drop of water is conserved, and

terrace cultivation is practised where there is a tendency for the soil to be washed down the hillsides. The region is well provided with railways and tram-lines. The article is well illustrated from the author's photographs, some showing the cylindrical *trulli* which are a characteristic form of dwelling in the country parts.

ARABIC NAME OF NELSON ISLAND

Dr. Osborne, in the *Bulletin de la Société Archéologique d'Alexandrie*, 1925, drew attention to the fact that the present name of the island off the Abu Qir peninsula was only given to it by British sailors to commemorate the battle of the Nile. On existing maps of that date the name is given as Abu Qir Island M. Etienne Combe in the *Bulletin* for 1929 points out that the island had its own Arabic name which is recorded by at least two oriental geographers, and which, though now generally forgotten, survives locally in a modern form. On the 'Ali of Sfax Arabic world-map of 1579 the name "*gun Aghrau*, Aghrau bay, appears. Further, an Arabic MS. in Berlin, which describes an attack on Alexandria by the Cypriotes in 1365, states that "Aghrau Island is situated opposite Abu Qir in the Mediterranean and Abu Qir is near Alexandria." M. Combe concludes that Aghrau Bay thus takes its name from Aghrau Island, which can be no other than the Nelson Island of present-day maps. The name is to-day in use among sailors of the region in the form *Gharau*, *Gharou*, or even simply *Gh'ro*. M. Combe therefore maintains that the name inserted on maps should be "Djazîrah Gharâw (Nelson Island)." This would be spelt Gezîret Gharâw" by the Survey of Egypt. No attempt is made to discuss the origin or meaning of the term Gharau.

LAKE ISSIQ-KÖL, CENTRAL ASIA

This salt lake, without outlet, presents some interesting features, particularly the relation which it bears to the Chu river, which, flowing at a higher level and coming within a few miles of its western end, turns away and breaks through a mountain range to the north-west. In the summer of 1925 a month's limnological investigations were carried out here by a party under the leadership of N. Keiser, who has published the results in a memoir issued as Fascicule 1 of a geographical series of the *Acta* of the University of Central Asia (Tashkent, 1928; in Russian with German summary). The observations included soundings, and records of the temperature, colour, transparence, etc., of the water, and have added somewhat to our knowledge of the form of the basin. The separation of the lake from the ocean is thought to have been due to a sinking of the crust during the Middle Carboniferous. The present relief dates from the Tertiary period when the lake-level must have been 400–500 metres higher than at present. Much of its water was drained off towards the Chu by the channel of the Kutemaldi, but the present still lower level seems to be due to desiccation. The shores are in general regular, being low on the north and west and on part of the south coast, but elsewhere high and steep. Similarly the western and northern parts are somewhat shallow, while as one goes east the depth increases, the deep water approaching the southern shore. Between the Sharbulun promontory and the mouth of the Ak-Terek the depth at 2–3 km. from the shore was 105 m., while at 3½ km. from the mouth of the Ton the greatest depth hitherto measured—605 m., or 1989 feet—was found. The blue colour of the water was more marked in the northern than in the southern parts, though the transparency was greater in the south, the rivers that enter here through narrow and fairly deep bays soon parting with their load of suspended material. As regards the vertical distribution of the temperature of the

water, it is noted that the variations within the limits of a given layer were greatest in the upper 30 m., the maximum range being 3·8° C. This is attributed to the action of the prevalent strong winds. Whereas the mean temperature of the upper layers was a little over 18° C., at 50 m. it fell to 8°, and at 240 m. to 4·5°. In nearly all layers the temperature was higher in the north than in the south.

VOLCANOES OF THE DUTCH EAST INDIES

As one of the most pronounced regions of volcanicity in the world the Dutch East Indies offer an unlimited field for study, and full advantage of this is being taken by Dutch scientific men, who of late years have added much to our knowledge in this department. In 1926 Dr. G. L. L. Kemmerling published a map in which all the known active volcanoes were shown, and numbered consecutively. Of a total of some 400 volcanoes known to exist in the Archipelago, 91 were put down as "active" (some now only in the fumarole stage), while 56 were known to have been actually in eruption in recent historical times. Soon after this a new map was issued as No. 2 of the *Bulletin* of the Netherlands East Indian Volcanological Survey, which, published monthly in English, has taken the place of the old reports issued in the *Tijdschrift van Nederl. Indië*. A third map (with list) was published by Mr. W. Easton in the volume 'Science in the Netherlands Indies,' but so rapidly have new data accumulated (1928 having been specially noted for volcanic activity in this part of the world) that this third map is now somewhat out of date, and a fourth has been compiled by Dr. Kemmerling and published in the *Tijdschrift* of the Royal Netherlands Geographical Society, July 1929. The number of active volcanoes recorded is now 106, the basis of the numbering being their position on the map, though volcanoes only lately recorded are given higher numbers intercalated in their proper place (topographically) in the original series. Besides recording on the map the varying characteristics of the volcanoes with the dates of latest eruptions, Dr. Kemmerling gives notes explaining the recent happenings which have called for revision of previous lists, some space being naturally given to the renewed outbreak of Krakatau in 1927 after quiescence for forty-four years (see *Journal*, vol. 72, p. 579). Details are also given of a severe eruption in the island of Paloweh (Paloe) in 1928, by which over two hundred of the islanders lost their lives. Apart from the many volcanoes of Sumatra, Java, and the eastern continuation of the line of the Sunda Islands, such phenomena are closely grouped in the north-eastern peninsula of Celebes and in Jilolo or Halmahera (with adjacent smaller islands), and our knowledge of the latter group has been considerably increased through the operations of the new survey of this part of the Archipelago. Of 60 volcanoes known to have been in eruption in historical times, no fewer than 39 have been in action since 1900.

THE RAINFALL OF AFRICA

Under the title "Der jahrliche Gang der Niederschläge in Afrika," Hellmut Schmidt presents a substantial summary of what is known about the rainfall of Africa and its seasonal distribution (Aus dem *Archiv der Deutschen Seewarte*, 46. Band Nr. 1, 1928). The contribution consists of seven maps of the continent, a few plates showing diagrams of rainfall for various places, a table giving the average annual and monthly quantities of rainfall for the hundred stations upon which the maps are based, together with descriptive and explanatory text. The seven maps of Africa show respectively the distribution of the stations, the times of the rain-seasons, the times of the chief rainy seasons, the duration of the rainy seasons as defined by the number of " rain-months" with

over 50 mm. (2 inches), the names of the rain-months with over 50 mm., the amount and number of rainy months with over 125 mm. (5 inches), and the range of the seasonal variation expressed as a percentage of the annual quantity. A defect of the maps is the absence of lines of longitude and latitude except in the loose index map, and in two others where they are not evaluated. A lengthy bibliography on the rainfall of Africa makes no reference to Knox's 'Climate of Africa.'

It is pointed out that the South-West Monsoon blowing off unduly warm water and meeting the great obstruction of the Cameroons Mountains brings an enormous rainfall to certain places—of the order of 400 inches a year. As there are probably wetter spots still, it is held, indeed, to be quite likely that the Cameroons, without any real dry season, may be found to possess the wettest spot on the globe. The importance of warm ocean currents, such as Guinea and Mozambique, in increasing the vapour-content of on-shore winds and so increasing rainfall, is emphasized, also the influence of cold currents such as the Benguela in reducing it. These, in conjunction with the effects of the relief of the land, are potent contributory factors in the distribution of rainfall, but they do not tell the whole story. The author gives no hint, in the explanatory part of his text, that it is difficult to understand completely the facts of rainfall distribution and its anomalies without reference to the convergence of air-currents, or, in modern terminology, to discontinuities or fronts. The equatorial or "zenithal" rainbelt is said to be convectional, without, however, any reference to the fact that the convectional rains take place in the trough or lane of relatively low pressure between the opposing Trades. In reality the ideal equatorial rain-belt nowhere exists. Everywhere it is locally distorted by land and water distribution, that is, by monsoonal factors. In Africa the Sahara prevents it from following the sun so far north as it does in Central America or South-Eastern Asia. In West Africa, in the Guinea lands, the South-West Monsoon currents, interacting with the dry northerly (Trade) winds from the Sahara region, augment the equatorial rain-belt, but in East Africa, in Italian Somaliland, it is subverted, partly because the wind opposition between Northern and Southern wind-systems is disturbed by the Persian Gulf low-pressure centre which controls the Indian Monsoon system.

FRENCH MISSION ACROSS SAHARA

During the early months of this year an expedition, led by H.R.H. the Prince Sixte de Bourbon, crossed the Sahara from Algiers to Lake Chad and back. The object of the mission was to open up a new French Trans-Saharan motor route, connecting North Africa with the Niger Colony and French Equatorial Africa, and through them with Nigeria and the Belgian Congo. The proposed reconnaissance was regarded with favour by the Minister of Air, as the route held out possibilities as a new airway, and by the Governor-General of Algeria, as it covered part of the itinerary for the motor race to be run early next year in celebration of the centenary of the French occupation of Algiers. The mission was also charged by the Museum of Natural History, the French Geographical Society and the Society of Commercial Geography with collecting information about the regions crossed.

The personnel of the mission consisted of H.R.H. the Prince Sixte de Bourbon, H.R.H. the Prince Gaétan de Bourbon, Count de Béarn (Naval Reserve), Count de Neufbourg (Air Reserve), Lieutenant-Colonel Gautsch (Commandant of the Motor-service Inspection of Algeria–Tunisia), Captain Bach (12th Artillery), one mechanic and one interpreter. The cars used were three lorries supplied by the Delahaye Company. These are very carefully

described in every technical detail by Colonel Gautsch in his account of the expedition published in the Supplement to *L'Afrique Française* for July, *Renseignements Coloniaux* No. 7. He states that the modifications made in the cars were only of the simplest kind and such as could be carried out on lorries of any type. Ordinary wheels were used, fitted with extra-large Dunlop tyres.

The expedition left Algiers on 26 January 1929 and made for Lake Chad by way of Ghardaia, El Golea, In Salah, Tamanraset, In Gezam and Zinder. The most interesting section of this outward journey was that between In Gezam and Tegida-n-Tesemt, as here the expedition had to find its own track, trying to identify the natural landmarks indicated by Commandant Rottier, who made a reconnaissance in May 1927 and suggested a motor route avoiding the foothills west of Aïr. Skirting the dunes of Idjederan, the convoy turned south down the T'immarsoi depression, which is a prolongation of the Wad Tafaset, and then along the eastern end of the Tesallaman, across Mr. Francis Rodd's route from Arli to Kidal in 1927 (see *G.J.*, Jan. 1929). In the Irazer of Agades they found the well of In Abbangarit to lie much farther south than is indicated on the 1/M map. A modification of Rottier's route suggested by the mission is shown in a special sketch-map illustrating this section of the journey. Beyond Tegida-n-Tesemt a detour to In Gall was considered advisable for the proposed motor route to avoid the very broken country west of the Aïr massif, and between Agades and Zinder a considerably longer route by Tessawa instead of the direct route by Gangara, as beyond Gangara there is a stretch of thick bush.

The return journey to Algiers, reached on April 16, was made by the western and better-known route via Gao, Reggan, and Colomb Bechar, which is periodically used by the Compagnie Générale Transsaharienne. Colonel Gautsch makes some useful comments on the water resources and surface conditions along different parts of the Gao–Reggan section. His remarks largely bear out those of Mr. Owen Tweedy on the same subject in the discussion following Mr. Leonard Scott's paper in the *Journal* for October (pp. 337–339). A number of suggestions are made as to other tracks feasible for motor transport, especially to avoid bad stretches on the present route. The general trend of the mission's conclusions, after their 10,160 km. trek across the Sahara, as to the probable commercial utility of a railway across this region, seems to be summed up in the closing words of the account of the expedition: "The mission hopes in this manner to have contributed in an essentially practical way to the development of Trans-Saharan lines of communication. The motor car provides an immediate solution of this problem, easy and amply sufficient for present needs, and without prejudice to measures of a wider character, such as a railway line, which may eventually be realized in the future."

On the recommendation of the mission the improvement of the Gangara–In Gezam section of the eastern route has been undertaken by the Governor of the Niger Colony, and Colonel Gautsch states that the route will be open for traffic by the beginning of 1930.

DESERT EROSION IN THE UNITED STATES

In the *American Journal of Science* for May 1929 Mr. Eliot Blackwelder has a paper on "Cavernous Rock Surfaces of the Desert." A familiar characteristic of rock outcrops in the semi-arid and desert regions of the south-western United States is the tendency to develop a pitted, honeycombed or cavernous surface. These cavities display great variety of form, but are commonly bowl or purse shaped, and vary in size from a few cubic inches to pockets big enough to shelter a horse and rider. They occur in many different kinds of rock and situation, though they are commonest in granitoid or rhyolitic rocks and on hills or low

mountains bordering plains. Such cavernous weathering has often been ascribed to the scouring effect of wind, but it should be remembered that in many localities where sandblast action has been most effective the rocks have been pitted, fluted, grooved and polished without forming the niches in question. It is apparent that solution will not explain the features since they are rarely found in limestone and other soluble rocks, being most common in such as contain little soluble material. Mr. Blackwelder considers that the mode of origin is complex. He comes to the conclusion that the disintegrated rock material induced by expansive chemical changes is removed by one or more of at least six different agencies of which wind is the chief. The wind has been found by field observations to be capable of entering and sweeping out thin chips of rock or grains of sand from many such cavities, but driving rains also play their part in enlarging them, as also do wet-weather rills and desert rodents which use the cavities as dens and shelters.

CONQUEST OF DROUGHT IN AUSTRALIA

In the issue of *Discovery* for April 1929 Sir John Russell, Director of the Rothamsted Experimental Station, indicates the advance made by agricultural research towards reducing the barren area of Australia. Apart from irrigation, which is of course limited by water supplies and contours, the breeding of drought-resisting strains of wheat, together with the application of the principles of "dry-farming" whereby soil moisture is conserved, has resulted in the steady encroachment of cultivation inland towards the desert interior of the continent. No one can say how far inland the wheat belt can be pushed, but every mile gained adds many thousands of acres to the present area. The result, in other words, of modern progress is that whereas thirty years ago 15 inches of rain per annum was regarded as the lowest safe limit for wheat, it is now grown regularly on a fall of 10 inches, provided this is suitably distributed over the year. In 1898, when Sir William Crookes made a very dismal forecast about the future of wheat production in Australia, that continent was only producing 38 million bushels of wheat, or only 2 per cent. of the world's crop. At the present time Australian production amounts to 161 million bushels, or 5 per cent. of the world's total, and is still increasing. It is stated that these drought-withstanding varieties of Australian wheat are not so high yielding as English wheats, but English wheats are quite unsuited to a dry climate. It appears that in the irrigable parts of Australia, chiefly in the Murray region, the soil, as in other dry regions, is in many places charged with soluble salts which do a good deal of injury to plants and render the satisfactory application of irrigation a difficult and costly process.

THE MOTIVES OF PRINCE HENRY THE NAVIGATOR

Sr. Joaquim Bensaude, who has done so much to elucidate the origins of nautical science among the Portuguese, had lately turned his attention to the colonial enterprise of the nation under Prince Henry and King João II, and has sent us the report of an address delivered by him on the "Origines du Plan des Indes" conceived by the Prince. He calls attention to the new light thrown on the events of that period by recent researches, notably those of M. de la Roncière on the relations maintained between Portugal and "Prester John" of Abyssinia long before the journey of Covilhão, spoken of by De Barros as the beginning of such intercourse. He also draws largely on the great work of Darras and Bareille on the "Histoire de l'Eglise' to show the general position in Europe at the time, especially the grave menace to Christendom caused by the persistent onslaughts of the Turks. He regards the central motive of Prince Henry to

have been his burning desire to save Christendom, on the one hand by maintaining at all costs the outpost held by Portugal in Morocco, and on the other turning the enemy's position by appearing in his rear in the Eastern Seas. In the European relations with Abyssinia the most important fact is held to be the offer of an alliance against Islam made by Prester John in 1427 to Alfonso V of Castile, by whom it was favourably received; but this was only one out of six different embassies sent from Abyssinia to Europe in the fifteenth century, that of 1452 having been received by Prince Henry. Sr. Bensaude dwells on the vain efforts made by successive Popes to rouse the European nations to a sense of their danger from the Turk, and holds up Prince Henry as the one man by whose chivalrous zeal and prescience the way was paved for the successful Portuguese action under João II. It is no doubt useful that the new evidence in support of this view should be clearly stated, even though the view itself is not now put forward for the first time. That the religious motive was always to the fore in the Prince's schemes has been fully recognized by other writers, among them Prof. Beazley, who dealt with this phase in an article in the *American Historical Review* in 1910. And though Sr. Bensaude says not a word of the more secular aims of the Prince in the field of commerce and colonization, we can hardly doubt that such played their part alongside of the crusade against Islam.

OBITUARY

LIEUT.-COLONEL ARTHUR CAMPBELL YATE

Colonel Arthur Yate was until about two years ago a familiar figure at our meetings, deeply interested in all geographical and political questions of Central Asia. Son of a Fellow of St. John's College, Cambridge, he was educated at Shrewsbury and at that College, and obtained his Commission in the Army from the University in 1875. For the greater part of the next thirty years he was on service along the Indian Frontier or travelling beyond it in Persia, the Caucasus, and Central Asia: was the author of several books and many review articles, and gave much time to organizing the Indian Branch of the Saint John's Ambulance Association. On his retirement from India his activities were largely given to the Central Asian Society, and during his five years' tenure of its Honorary Secretaryship, from 1918 to 1923, he was indefatigable in organizing its meetings and securing lecturers covering a wide range of subjects. His death, at the age of seventy-six, after a long illness, makes ours and kindred societies regret the loss of an active and accomplished soldier and traveller.

CAPTAIN JOHN PERCY FARRAR, D.S.O.

Captain Farrar was one of the family of brothers whose names are prominent in the history of South Africa: but he had already made a sufficient fortune and retired from the business of constructing agricultural and mining machinery when the outbreak of war in South Africa in 1899 called him back. He held a commission in the Kaffrarian Rifles, was severely wounded, and gained the D.S.O. From that time he gave himself especially to mountaineering, was a very prominent member of the Alpine Club, and for many years was an editor of

the *Alpine Journal*. When the Mount Everest Committee was formed in 1920 Captain Farrar was a Fellow of our Society, but sat as one of the four representatives of the Alpine Club; and he undertook the principal responsibility for stores and equipment of the first two expeditions. He had a forceful way with him on this committee: it was, for example, entirely due to him that in the list of subscriptions to the Mount Everest Fund the contributions of the Alpine Club appeared to outweigh those of this Society. To the great regret of his colleagues he resigned from the Committee before the third expedition was organized.

Captain Farrar was reckoned by his fellow-members of the Alpine Club as good a man upon a mountain as they could hope to see. He kept until the end of his life his youthful vigour and habit of mind, and after he was seventy he still took part in first-class expeditions in the Alps. The Editor of this *Journal* has often to exchange information or material, such as mountain photographs, with the Editor of the *Alpine Journal*. He will retain the liveliest appreciation of Captain Farrar's exceptional capacities as editor and critic.

ADMIRAL SIR ARTHUR CAVENAGH LEVESON, G.C.B.

Sir Arthur Leveson had been a Fellow of our Society for more than thirty years: he was elected while still a lieutenant in 1896, became a Rear-Admiral in 1913, served in the Grand Fleet at the Battle of Jutland, and as Admiral was Commander-in-Chief on the China Station in 1922–24. He had just been elected to the Council when his death occurred. He was endowed with brains of an exceptional character, with great power in the acquisition of all sorts of knowledge and information. Those who partook of his ever-ready hospitality would be sure to find the map and book relating to the latest topic of interest laid on his table, and would listen to his incisive judgments with pleasure and interest.

It was indeed remarkable that one whose life had been largely spent in the study of the more material side of an exacting profession should have found time to assimilate a knowledge of history and geography combined that was far above the average. His genial presence will be greatly missed. W. E. G.